VOL. XXXV. — No. 12. DECEMBER 1958.

Monthly Bulletin of the International Railway Congress Association

(English Edition)

FLEXIBLE OPERATING CHARACTERISTICS

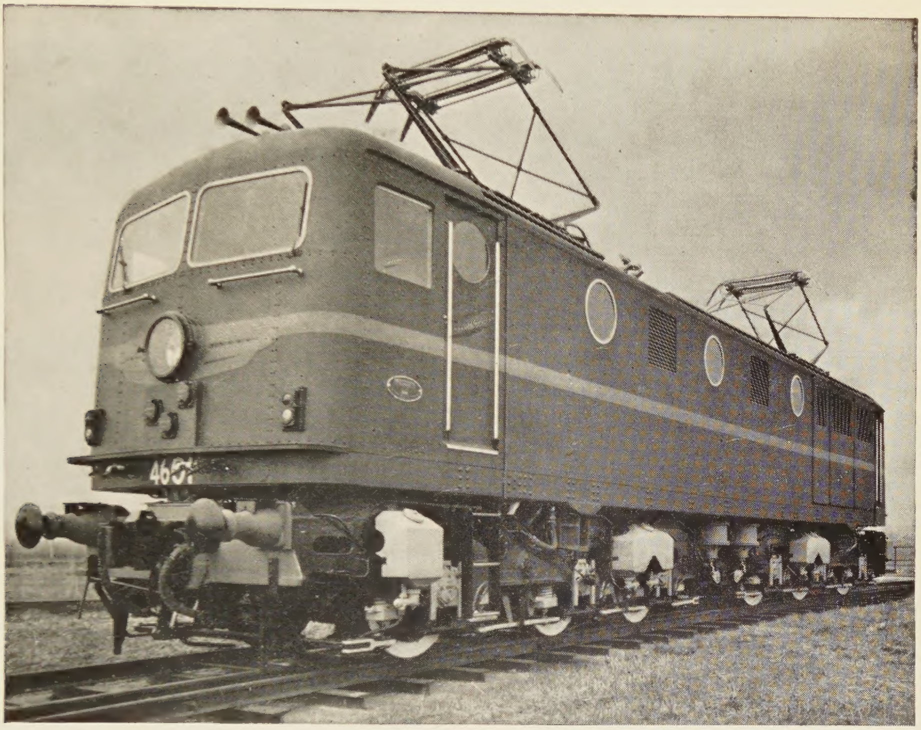


Photo by courtesy of Metropolitan-Vickers Electrical Co. Ltd.

Forty of these mixed traffic electric locomotives built by Metropolitan-Vickers Electrical Co. Ltd. are operating on the Parramatta-Lithgow electrified system of New South Wales Government Railways.

Designed with flexible operating characteristics for a heavily graded route, and for multiple unit working from any driving cab, these locomotives are equipped with

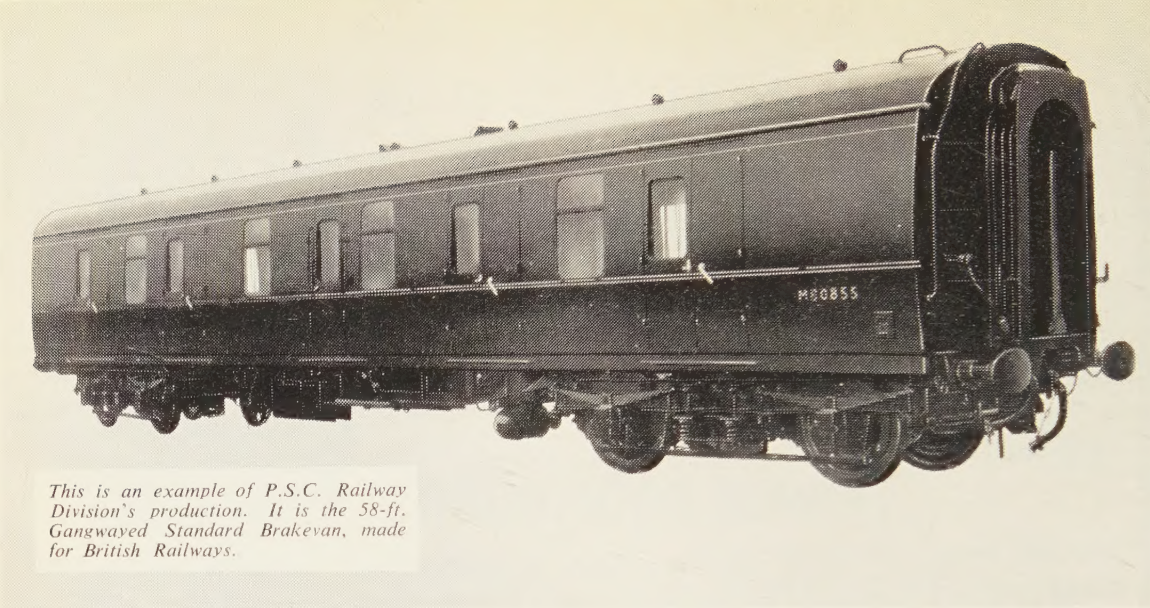
WESTINGHOUSE

Type **A. 7 EL AIR BRAKES**

supplied jointly from the Australian and English Westinghouse factories

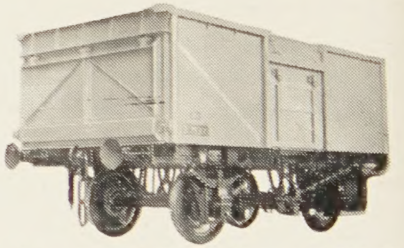
Westinghouse Brake and Signal Co. Ltd., 82 York Way, London, N.1

Alphabetical Index of Advertisers



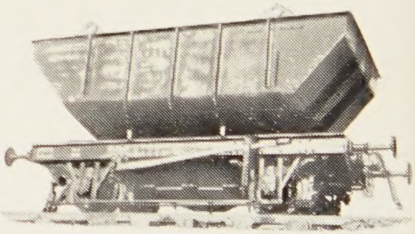
This is an example of P.S.C. Railway Division's production. It is the 58-ft. Gangwayed Standard Brakevan, made for British Railways.

Pressed Steel deliver the goods all over the world



16-ton all steel Mineral Wagon. 72,000 of these have already been delivered from our Paisley works.

In the last ten years Pressed Steel have manufactured enough railway wagons to make a train more than 300 miles long; which isn't just a frivolous statistic, for it reveals the enormous capacity of Pressed Steel Company's works at Paisley for large and varied orders. Indeed, as their record shows, Pressed Steel can make rolling stock in any quantity to any specification for any gauge in any part of the world—quickly and at competitive prices. This page shows just some of the wagons made for some of their customers at home and overseas.



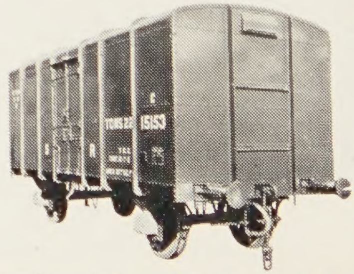
V. J. M. Hopper-type Wagon with drop bottom door for coal, as used by Queensland Government Railways, Australia.

PRESSED STEEL COMPANY LIMITED

RAILWAY DIVISION, PAISLEY, SCOTLAND

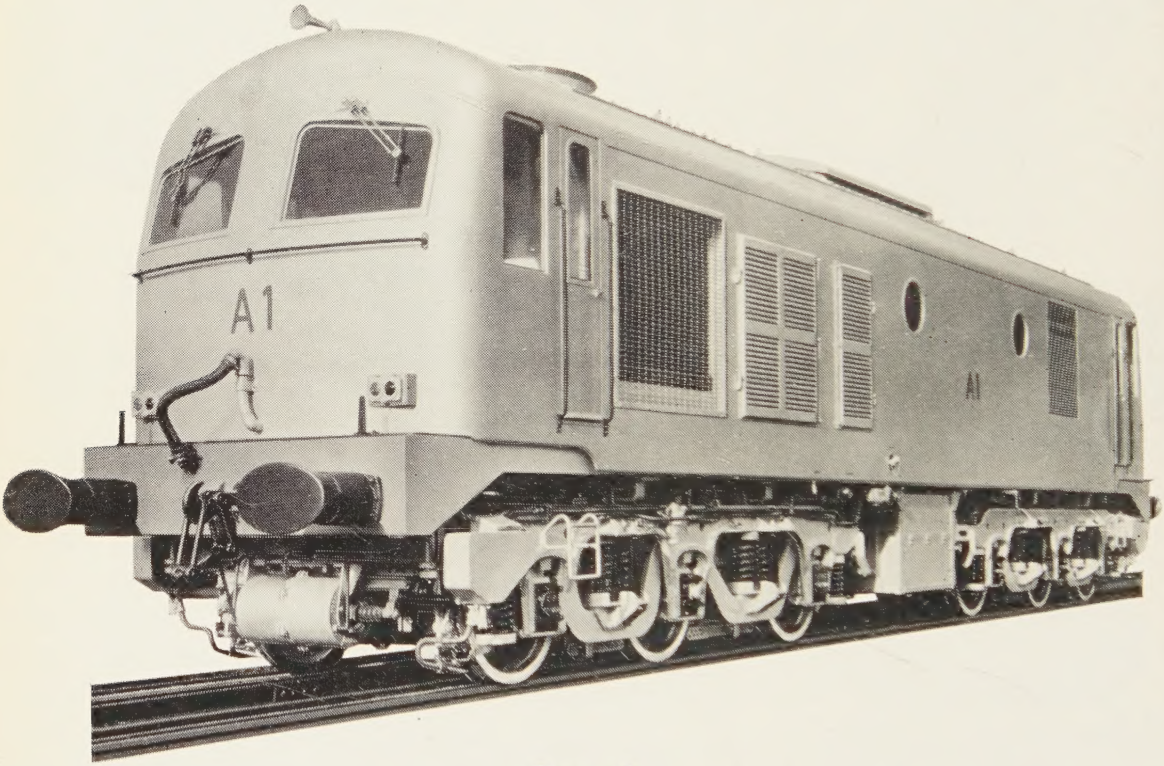
Head Office: COWLEY, OXFORD. *London Office:* 169 REGENT ST., W.1

Manufacturers also of Motor Car Bodies, Prestcold Refrigeration Equipment and Pressings of all kinds.

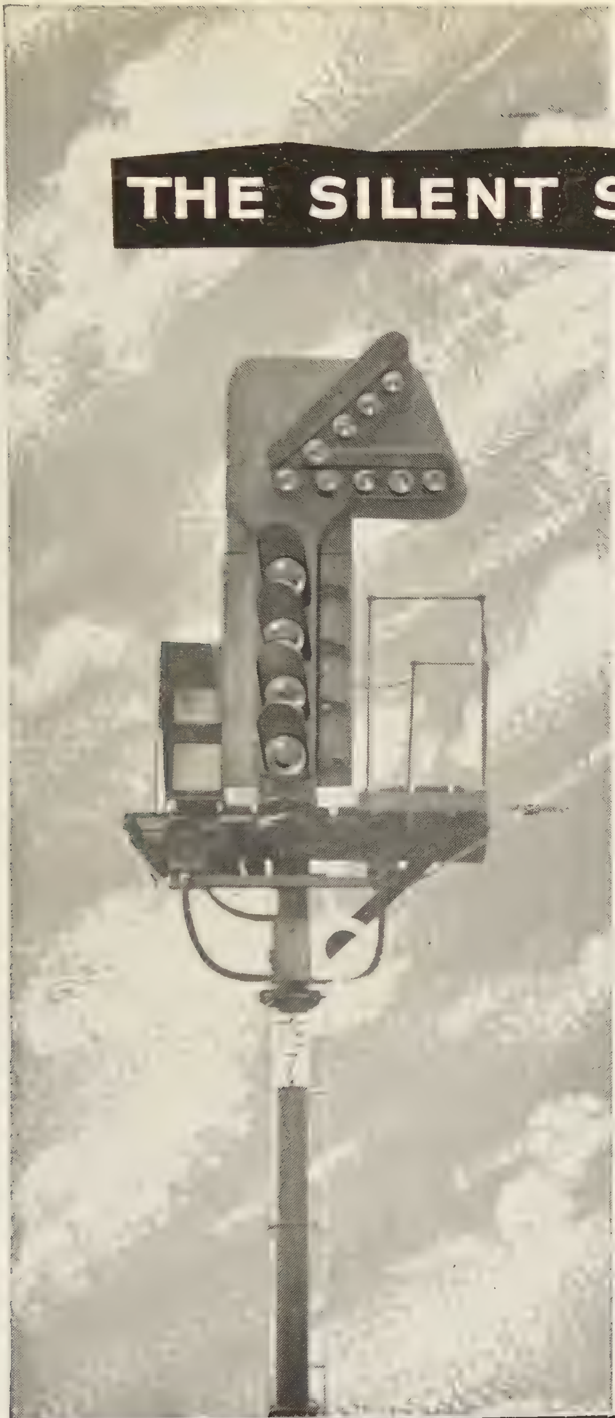


Broad gauge Covered Wagon type C.R. as used by Indian Railways.


BARBER


A1
A1

THE SILENT SENTINEL



ON GUARD...
NIGHT & DAY

The railway signals you instal this year will still be working for you in 20 or even 30 years' time, safeguarding the trains and those who travel in them, without cessation.
In all weathers they do their vitally important job, often in smoke laden conditions, and always subject to constant heavy vibration—yet their reliability must never for a single moment be in doubt.
With so much at stake, how right you are, how wise you are, to rely on . . .

S.G.E. SIGNALS
AND
ROUTE INDICATORS

SGE

SIEMENS AND GENERAL ELECTRIC RAILWAY SIGNAL CO. LTD.
EAST LANE · WEMBLEY · MIDDLESEX · ENGLAND


RAILS
FISH PLATES
SOLE PLATES
WORKINGTON
FROM:
WORKINGTON
IRON & STEEL COMPANY
WORKINGTON · CUMBERLAND · ENGLAND
HEY-BACK RAIL FASTENINGS
THE UNITED STEEL COMPANIES LTD
JOHNSON

MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

PUBLISHING and EDITORIAL OFFICES : 19, RUE DU BEAU-SITE, BRUSSELS

Price of this single copy : 80 Belgian Francs (not including postage).

Yearly subscription for 1958	Belgium	700 Belgian Francs
	Universal Postal Union	800 Belgian Francs

Subscriptions and orders for single copies to be addressed to the General Secretary, International Railway Congress Association, 19, rue du Beau-Site, Brussels (Belgium).

CONTENTS OF THE NUMBER FOR DECEMBER 1958.

CONTENTS *(continued)*.	Page.

LIBRARY
OF THE
Permanent Commission of the International Railway Congress Association

READING ROOM : 19, rue du Beau-Site, Brussels.

Works in connection with railway matters, which are presented to the Permanent Commission are mentioned in the « Bulletin ». They are filed and placed in the library. If the Executive Committee deems it advisable they are made the subject of a special notice. Books and publications placed in the reading room may be consulted by any person in possession of an introduction delivered by a member of the Association.

Books, etc., may not be taken away except by special permission of the Executive Committee.

The Permanent Commission of the Association is not responsible for the opinions expressed in the articles published in the « Bulletin ».

An edition in French is also published.

Vol. XXXV. — No. 12. December 1958.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[385 .114]

Guide to the theory of prices for transport specialists, (*)

by Jürg NIEHANS,
Professor at the University of Zurich.

INTRODUCTION.

A surprisingly large number of authors have written books on the economy of transport completely ignoring the assistance which the theory of today's prices might have given them. They have either used methods relegated years ago to the museum of economic doctrines; or else they have reported some part of the appropriate methods without making use of same in the solution of concrete problems. In the first case, when the transport specialist is not well informed concerning the fundamental ideas of the theory of prices, a remedy can quickly be found: all that is needed is to make use of one of the excellent introductions to the theory of prices which are now available. In the second case, when the general theorems of the theory of prices have been applied in a far from satisfying way to the special field of transport, it is harder to find a remedy through lack of guidance. It is therefore necessary to create a link between the general theory of prices and the economics of transport. This is the object of this present article, at least within certain limits, as follows :

In the first place, we will only deal with the *formation of the prices*. We will not study the costs, nor the demand for traffic facilities (or more exactly the idea that transport undertakings get concerning prices and the demand for transport); we will take these as known. We will not deal either with the controversial question of costs in transport, nor that of the conditions which determine the demand (1).

Secondly, we take as an example a transport undertaking whose sole object is to make *as much profit as possible* or, in the most unfavourable case, to reduce its losses to the minimum. We

(1) In particular, we take it that the curves of costs and demand remain continuous.

(*) The text which follows is the revised and corrected translation of the article « Preistheoretischer Leitfaden für Verkehrswissenschafter » (*Schweizerisches Archiv für Verkehrswissenschaft und Verkehrspolitik*, 11th year, No. 4, 1956). We have not included the lengthy mathematical appendix; we have also left out the references to certain special problems of the theory of prices; on the other hand, we have extended and gone further into the exposition of the theory of costs.

are fully aware of the fact that an undertaking of this kind would be rather exceptional at the present time, but we have three reasons for making use of an example of this sort : first of all, even those transport undertakings which are more or less concerned with considerations based on the public economy frequently make their decisions, all the same, in the same way as an undertaking whose objective is profit; in addition, it is impossible to appreciate in a satisfactory manner non-lucrative considerations of « public economy » except in relation to lucrative considerations; finally, it is so much more difficult — even if it is possible — to study the functioning of « public economy » than that of private economy, that we must start off by supposing — if only for didactic reasons — that a profit making motive exists. This hypothesis clearly limits the question and also the scope of the replies.

We will also take it that the transport undertakings have an *autonomous price policy,* i.e. they do not allow their prices to be dictated by an anonymous market, but on the contrary, they exercise an essential influence on the prices. There is no doubt that this condition corresponds to reality at the present time, even if there are certain exceptions.

Remembering the above stated limits, the question to which we propose to give a reply may be enunciated as follows : How should a transport undertaking decide what price to ask for a given service in order to realise as great a profit as possible, once they have obtained a certain idea of the costs and the possibilities of sale ? Our reply will in fact consist of several partial replies, according to whether the undertaking only offers a single category of service or several, according to whether it has only one market, or several separate part markets, or connected part markets. Going from the simple to the complex, we are going to discuss the following four problems :

I. Fundamental ratios between costs and demand in fixing the prices in the case of a transport undertaking offering only one type of service on a single market;

II. Differentiation of the prices according to variations in the demand, in the case of an undertaking offering a single service in several separate partial markets;

III. Importance of the possible interdependence of the demand on two connected partial markets;

IV. Effect of differences in costs on the prices in the case of an undertaking offering several transport services with different costs, i.e. an undertaking with multiple products.

In each of these chapters, we will first of all enunciate the problem, then formulate a general solution, and finally apply this solution to the special case of transport.

I. FUNDAMENTAL RATIOS BETWEEN COSTS AND DEMAND.

A. Enunciation of the problem.

To get a better idea of the effect upon the making up of the prices the ideas of an undertaking has about its

costs, on the one hand, and the demand for its services, on the other hand, let us take first of all the case of an *undertaking offering only one product on a single market*. For example, let us suppose a road transport undertaking always offering services over the same routes. The number of tickets which can be sold at different acceptable prices will represent the demand or, in other words, the sales possibilities of the undertaking. For each quantity of services given, it will be possible to evaluate the costs. As regards the demand, it is necessary in particular to know its degree of reaction to variations in the price. The sensitivity of the demand is generally measured from the increases in the services, expressed as a percentage, which can be expected from a reduction of 1 % in the prices.

How does a price which should show a maximum profit depend upon evaluating the demand and the costs, and in particular, the sensitivity of the demand ?

B. **General solution.**

The general solution of this problem is so simple that one is tempted to call it banal.

It is obviously of interest to reduce the price whenever the expected increase in traffic as a result promises to give an increase in receipts which will be greater than the resulting increased costs. On the contrary, it is of interest to increase the price every time the receipts increase or a fall in receipts is compensated by the saving in costs to be expected from the decline in traffic. The optimum price is, therefore, achieved when for every reduction in prices the corresponding additional costs are greater than the additional receipts or for every increase in prices there is a greater reduction in the receipts than in the economy in expenses.

These considerations show the path that must be followed in fixing the rates :

1. A given rates structure will be selected as a starting point. To select from the start as favourable a tariff as possible saves trouble afterwards. In practice, we start with the tariff in force;

2. We will take a given item of the tariff selected and examine whether it should be increased or reduced according to the criteria reported. If this cannot be decided with certainty, the price in question will not be altered until the matter comes up again. Otherwise, the basic tariff will be modified as a result;

3. This process will be continued until there no longer remain any tariffs which can be modified according to the above criteria.

In certain specially favourable cases, it is possible to proceed systematically and obtain the best tariffs with certainty; this is the domain of modern « operational research ». In a great many cases, it is not possible to obtain this certainty with the present methods. However, in general, the application of the proposed process will make it possible to realise considerable improvements : we do not completely achieve our object, but we come very close to it. There is no better method in existence

as yet for fixing a tariff which will make it possible to obtain a profit.

When the improvement of the tariff has been finished, it will be found that it satisfies a simple condition : If any item of the tariff is slightly modified, the modifications in the receipts will be equal to the modifications in the costs. In the modern theory of costs, this fact is expressed by the following sentence : « The best price is that which makes the marginal receipts equal the marginal costs. There is no reason to doubt the exactitude of this axiom. It only describes, however, the final result of an improvement process. »

It is not quite so simple to establish the ratio between the optimum price and the reaction of the traffic to the price. Obviously, a reduction in the prices is the more indicated the more it is likely to increase the receipts. But this increase in the receipts will be the greater as the traffic increases more quickly owing to the reduction in the price. Naturally, raising the prices produces the opposite reaction. Consequently, the *optimum price is the lower (higher) as the traffic reveals itself to be more (less) sensitive to variations in prices*. In the theory, this sensitivity (or elasticity) of the demand is defined by the ratio of variation as a percentage of the traffic to the variation in percentage of the price.

C. Application to transport.

The application of this general solution to transport raises no *particular* problem. The empirical evaluation of variations in costs and demand is however always somewhat uncertain. But such problems of evaluation are not limited to transport; their solution is linked up with the statistics and economy of the undertaking. On the other hand, there is no « particular theory of transport prices »; it would therefore be erroneous to advance in this connection affirmations which contradict the general solution given above. A few examples will make this clear.

1. It would be false to state that transport prices do not depend upon the costs; it would also be false to take it that they are determined by the costs alone; it is clear from the general solution that both costs and demand contribute equally to determining the optimum price, and in what *way*.

2. « The upper price limit is fixed by what the customer is prepared to pay, whilst the lower limit is fixed by the costs. » It is time to banish this formula to the scientific museum, where it should have been for the last half century. In transport likewise, the optimum prices are clearly defined, at any rate under the conditions in force here. In addition, the appreciation of a service and its costs generally differ as a function of its quantity, so that it is not possible to precise the limits of the prices sought after.

3. It is false to state that a service is profitable for a transport undertaking as soon as the price which can be asked is higher than the additional cost it involves. The additional cost must not be compared with the price but with the additional receipt; the latter is fre-

quently less than the price. A service can therefore cease to be profitable although its price is higher than the additional cost. Consequently, the prices of the transport services are generally higher than the marginal receipts.

4. Only *variations* in the costs and receipts come into the picture. The costs which do not vary with the prices, in other words the fixed costs, do not matter in fixing the optimum price : there is no interest in knowing the amount of the fixed costs, nor over how many services they are spread and be in possession of the key which the accountants use for dividing them up. The only ones that count are the additional costs which a reduction in the price gives rise to through the increase in traffic (or the saving made possible by an increase in the price due to the decrease of the traffic). The following remarks may clear up any misunderstandings on this point :

a) By marginal costs, we must not think we are considering the increased costs due to an infinitesimal increase in the volume of traffic (for example a single additional passenger or the celebrated « ton in addition », etc.). This usually leads to erroneous conclusions. It is better to consider what will be the costs which depend upon the tariff modifications in question;

b) We do not pretend in any way that the prices should be fixed at the level of the marginal costs; in general, they will be higher;

c) It will be argued that by using the method indicated, the transport undertaking can only cover its variable costs and not its fixed costs, and consequently, it must expect losses. This worry is baseless. In reality, the process given makes it possible to cover the costs in the most favourable way, taking into account momentary circumstances. If there is any loss, we can be sure that it is not greater, but even lower than that which would have occurred with any other price policy. In particular, the « covering of the fixed costs » can lead in reality, as is easily demonstrated, not to an improvement but very easily to a deterioration in the way the costs are covered. He who endeavours to fix the prices as a function of the total costs involved must therefore expect to obtain a less favourable covering of the costs than if he had left the fixed costs out of the picture;

d) The foregoing considerations do not mean that the fixed costs are of no importance in the economy. On the contrary, they are extremely important in the development of the profit or loss. We merely mean that the fixed costs must not be taken into account when deciding the prices policy;

e) Neglecting the fixed costs does not imply in any way neglecting the costs of the fixed installations, the costs of the permanent way, stations, etc. Only those costs which are not affected by a modification in the tariffs are fixed. If the reduction of a tariff makes it possible to expect such a great increase in the traffic that the existing installations will have to be extended, it is obvious that the cost of this extension is part of the marginal costs which have to be taken into account.

The application of the general theory of prices to transport may perhaps upset certain conceptions that have been fostered in many books on transport. The solution here proposed is however not new in any way. It is not the property of the author, since it was already the common property of the best treatises on social economy in the years before the first world war.

II. DIFFERENTIATION OF THE PRICES IN VIEW OF AN INDEPENDENT DEMAND.

A. Enunciation of the problem.

So far we have taken it that the transport undertaking has fixed a single price for all its services. In reality, it can often improve its position by selling similar services at different prices, by « differentiating » the prices. This differential treatment consists in subdividing the market into several partial markets. Let us take it provisionally that this dividing up is perfect, that the variations in prices on a partial market have not the least effect upon the demand in the other markets, consequently that the demand of a partial market is independent of that of the other markets. On what criteria will the differentiation of the prices in these independent markets depend ? What criteria determine the extent of the differentiation ? As in the previous chapter, we will take it that it is question of an undertaking offering only a single service.

B. General solution.

The rule valid for a single market also holds for each partial market : the price which promises the greatest profit is the lower the greater the sensitivity of the demand. Other circumstances have no effect. In particular, a comparison of the « predisposition to pay » on two partial markets does not make it possible to evaluate the differences in prices; the latter do not depend upon the absolute level of the « predisposition to pay » but upon its variation as a function of the quantity spent. The latter is measured precisely by the sensitivity of the demand. Consequently, in the case of independent partial markets, *one of the prices is lower than the other whenever (and only in this case) the market in question is more sensitive to variations in price than is the other.*

In general, it is only possible to appreciate reactions in demand by carrying out special enquiries. Such enquiries should be part of the most important preparations in any revision of the tariffs. However, certain empirical rules facilitate the first steps taken :

1. *The rule of substitution :* All conditions being equal moreover, the sensitivity of the demand is generally the greater the more easily the service in question can be replaced by others. For example, the sensitivity of the demand for X brand chocolate is greater than that of the total demand for chocolate, because it is easier to replace X brand chocolate by other brands, whereas chocolate in general could not be replaced so easily by an other commodity. It can also be said that X brand chocolate is « more subject to vigorous competition » by other brands than is chocolate in general by confectionery or cigarettes;

2. The « *rule of supplements* » *:* The sensitivity of demand for a service is the smaller — all other conditions being equal moreover — as the supplements to the service in question (i.e. the other services which are used with it) are the greater. If possibilities of substitution increase sensitivity of demand, the existence of supplementary services reduces it;

3. A « *rule of incomes* » has also been sought which would link up sensitivity of demand with the incomes of consumers. All that can be stated in this connection is that the sensitivity of demand to variations in price is reduced when the income of the consumer is increased, whenever the sensitivity of demand to variations in income increases with an increase in prices. This complicated rule does not teach us a great deal. It shows that we cannot count upon a reduction in sensitivity simply because incomes increase. It can be admitted that there is less budgeting « down to the last cent » as incomes increase and consequently the sensitivity to prices decreases. But this rule is less trustworthy than the previous ones.

These three empiricial rules make it possible to form a first idea of the fundamental problems of differentiation arising in transport.

C. **Application to transport.**

In no other field do differentiations of prices play so great a role as in transport. We cannot go into them all. We will simply show how these measures result from the general rules of differentiation.

1. *Ad valorem tariffs.* « All conditions being equal, the price of transport is the higher when the specific value of the goods transported is high. » The exactitude of this principle and its limits depend directly upon the « rule of supplements ». Let us take goods X to destination B, divided into two parts : on the one hand, the goods X at the starting point A, on the other hand, the transport from A to B. According to the rule of supplements, the best price of transport is the higher, the greater the supplement to the transport, and consequently the higher the value of the goods at the starting point A. The desire to make a profit also leads to *ad valorem* tariffs; consequently, it is not necessary to refer to considerations of public economy in order to justify this.

This rule is also valid in the case of passenger transport. Most often it is not possible to reap the advantages expected from a journey (holiday, profit, etc.) without other expenditures in addition to the cost of travelling (board and lodging, etc.). The price of transport will therefore be the higher as these supplementary costs are higher, and vice versa. Consequently, return tickets for limited periods for short distance excursions, sporting events, exhibitions, etc., are often cheaper than those having a longer period of validity. If it is admitted that passengers in the higher classes make relatively higher supplementary expenses, it must be concluded that the difference between the classes should be greater than the differences in cost. Finally, in the case of single journeys (moves, very long holidays), supple-

mentary costs often play a very important part, which contributes towards justifying the reduced price for return tickets compared with two single tickets.

2. *Competitive tariffs.* — According to the principles of competitive tariffs, the price of a transport is fixed the lower the greater the competition. The amount of competition is simply a measure of the facility with which the transport in question can be replaced; this principle is therefore only an application of the rule of substitution. A transport service can be replaced in two ways : on the one hand, the same goods can be carried by a competing method of transport; on the other hand, the goods to be transported can be replaced by others. Sugar beet can be sent by road instead of by rail; or cane sugar can take the place of beet sugar. The tariff will therefore be the lower according to the ease with which the transport can be replaced, on the one hand, and the goods substituted by others, on the other hand.

The last years have appreciably modified the relative value of the two components : when the railway had a « monopoly », the rule of supplements and with it the *ad valorem* tariffs reigned supreme; the development of the motor vehicle and the aeroplane have brought the rule of substitution to the fore. The tariffs, which do not as yet reflect this change, are therefore no longer the best today.

3. *Tariffs based on the distance.* — Are there circumstances enabling one to conclude, that for equal costs, the best transport price increases or decreases in general with the increase in the distance ? [1]. The general differential rules give a reply lacking in precision. It is often possible to replace transport over short distances more easily than long distance transport; instead of going by train, a small journey can be made on foot, by bicycle, horse vehicle or motor vehicle; in these cases the best price increases with the distance, in conformity with the rule of substitution. But the contrary may also be true : two transport undertakings may be competing against each other for the long distance services but not the short (the railway and navigation services between the two coasts of America). In this case, a transport undertaking may charge less for long distance transport than for short distance. According to the structure of production, the competition between different goods to be carried may have the same consequences as competition between different methods of transport. The short distance transport need not necessarily therefore be cheaper than the long distance transport. An analysis of each service will show if the sensitivity of demand increases or diminishes with the distance. Any valid judgement on tariffs based on distance therefore requires a thorough knowledge of the transport system and the structure of production.

4. *Tariffs according to income.* — It would be pleasant to be able to admit

[1] It should be added that : 1) provisionally, it is only question of a staging of the prices as a function of the demand; the differences in costs will be discussed later; 2) the stages in question do not concern the price per *kilometre* but the *act of transport*.

that the elasticity of demand decreases as the income increases. An empirical rule of this kind would justify the most varied price differentiations (transport of emigrants and natives, cheap workmen's tickets, reductions for soldiers and families). It can be admitted that a low income encourages budgeting down to the last cent. But this hypothesis must be verified; that is why it cannot be used as a solid basis on which to judge tariff measures. Here again, account must be taken of the elasticity in each particular case.

III. DIFFERENTIATION OF THE PRICES IN CONNECTION WITH LINKED UP DEMANDS.

A. Enunciation of the problem.

In the previous discussion, we admitted the hypothesis of independent markets; the demand on one partial market was not influenced by variations in prices on another partial market. This condition often corresponds to reality : the quantity of sugar beet to be transported is hardly affected by a modification in the tariffs applicable to spare parts for aeroplanes. It may happen, however, that the above condition does not correspond to reality. A modification in the rates for coal may very well have repercussions on the demand for transport for iron ore or coke; a modification in the prices of ordinary return tickets may have repercussions on the demand for cheap Sunday tickets, etc. The demand on one partial market does not only depend upon the price on this market, but also on the price on other partial markets. We must now consider the effects of this interdependence of demands. We will continue to suppose that it is question of an undertaking offering only one service; differences in costs play no part.

B. General solution.

The best price on each partial market is the lower the greater the sensitivity of demand on this market. In addition, on interdependent partial markets, the repercussions on the other partial markets have their effect. The price on the partial market A is the lower as :

1) the partial markets on which the demand increases as the price A is reduced are more numerous and more important, and the greater their reaction;

2) the partial markets where the demand decreases when the price A is reduced are less numerous and less important, and their reactions are less.

It is not possible to ascertain and verify this rule without the aid of mathematics. Its truth is however obvious intuitively. The advantage of a reduction in price on the partial market A is the greater when it also increases the demand on the other partial markets on which the prices remain unaltered. On the contrary, the advantage is reduced when the demand on other partial markets falls off simultaneously.

This supplementary rule can be simplified by means of the two ideas already mentioned. The other transport services the quantity of which is increased when the cost of the service A is reduced are in effect *supplements;* the transport services the quantity of which falls off

are *substitutable services.* Therefore the price of the transport service A will be the lower as :

1) *the supplementary services of the same transport undertaking are more numerous, more important and more sensitive;*

2) *the services of the same transport undertaking which can be substituted are rarer, less important and less sensitive.*

Wherever supplements and substitutes play a part in the programme of the services offered by the same undertaking, this supplementary rule must be taken into account. However, a certain reservation must be made. As the rules formulated for differentiation in the case of interdependent demands are only valid when substitute services predominate amongst the services of the same transport undertaking. This should be the normal case. If the supplementary services predominate, the rules may be reversed, often with paradoxical consequences.

C. Application to transport.

First example. — A bus service links up places A, B and C. A railway line competes with the bus between A and B, but not between B and C :

It is admitted that in view of the tariff regulations, the bus fares between A and C are equal to the sum of the two part sections A-B and B-C. What fares shall be charged on these two part sections ? According to the rule of substitution, the bus service will fix lower fares for the competitive section A-B than for the non- competitive section B-C. However, the two sections constitute a supplement for the passengers between A and C; reduced fares on the first section will also increase the traffic on the second section. In conformity with the rule of supplements, the result is a supplementary reduction of the fare for the section between A and B.

Second example. — A railway line from A to B, an industrial centre, is competed against by a canal; another line of the same undertaking from C to B does not suffer from any competition :

According to the rule of substitution, the railway tariffs, for example for the transport of coal, should be differentiated in favour of the section where there is competition. If coal is also carried from C to B, the quantities carried on this line will decline, as well as the receipts, owing to the reduced rates for coal coming from A; this is not an argument in favour of a differentiation in prices. On the other hand, if the iron ore which has to be dealt with with the coal at B comes from C, the two lines are supplementary, and the

differentiation of prices in favour of A-B will be strengthened as in the first example.

Third example. — A railway undertaking charges higher prices for first class passengers; it must take into account the fact that any increases in these prices may reduce the demand for first class travel, in particular by passengers changing class. However, the change over to second class is not an absolute loss, since it increases the second class traffic and receipts; the two classes are therefore substitutable. The difference between the tariffs for the two classes can only be determined by taking these two factors into account.

IV. EFFECT OF DIFFERENCES IN COSTS.

A. Enunciation of the problem.

The foregoing study is valid solely in the case of an undertaking offering only one service; it is therefore only valid on condition that all the services offered appear identical to those *who offer them,* i.e. they can be exchanged at will, without modifying the costs. It may happen that on occasion this condition is fulfilled in the case of transport, for example in the case of a pipe-line carrying exclusively petrol from A to B. But generally a transport undertaking offers a great number of varied services. The cost of two kilometric tons varies according to the route, the time of day, the season, the category of goods, the quantity of goods, the speed, the type of vehicle, etc., to such an extent that these kilometric tons no longer have anything in common bar their names, just as quills may be either pens or feathers; in certain cases the costs differ by as much as 1 to 100. In addition, the number of transport services is very great; it will give us some idea when we remember that there are nearly 320 000 different services on the Swiss Federal Railways between the 800 stations available for passenger services. A *transport undertaking* is distinguished therefore by its very marked character of an *undertaking offering multiple products;* in practically no other economic field is the character of a multiple product undertaking so pronounced or of such fundamental importance as in the case of transport. The fiction of stating that a transport undertaking only offers services of the same kind, for example homogeneous kilometric tons, can be very useful from the didactic point of view; it is sterile in the case of empirical studies; in fact it is even a source of error in many cases. The « specialisation » of the prices according to the type of service offered must therefore be added to the « differentiation » of the prices according to the demand. On what do the differences of prices in the case of an undertaking offering multiple products which is endeavouring to obtain a profit on interdependent markets depend ?

B. General solution.

All the determining factors in the case of an undertaking offering only one service continue to play a part when it is question of an undertaking offering multiple products; but the differences in the cost of the various services lead to

supplementary differences of price. It is necessary to define the influence of this new factor.

Neither the « complete » costs of the different services (including part of the fixed costs), nor the variable average cost are of importance, but rather the additional cost which must be expected when increasing the quantity produced, in other words the costs which might be saved were the supplementary production in question given up (see above, section I, C. 4).

To fix the price p_a for the service A, it is necessary to take into account not only the marginal costs of this service A, but also that of its supplementary and substitute services, to the extent to which they are offered by the same undertaking. When p_a falls, three groups of costs must be considered :

1) the supplementary costs occasioned by the increase in the quantity of the services A themselves;

2) the supplementary costs occasioned by the increase in the quantity of supplementary services for which the demand increases when p_a falls;

3) the costs saved by the reduction in the quantity of the substitutes for A.

The total effect of the costs on the price is the result of these three constituants. The best price p_a for the transport service A, compared with the prices of the other services, is therefore the *lower* as :

1) *the direct marginal costs of A are lower;*

2) *the marginal costs of its supplements are lower;* and

3) *the marginal costs of its substitutes are higher;*

compared with those of the other transport services. We will continue to suppose that the substitute connections predominate over the supplements.

The marginal costs of the different services of a multiple product undertaking are generally interdependent. Two cases must be distinguished : if the production of one of the services makes the other more difficult, we speak of *alternative products;* the marginal costs of the one are the higher as the quantity of the other is the greater. If the production of one service facilitates the other, the two services are *linked products;* the marginal costs of one service become smaller as the quantity of the other increases.

C. **Application to transport.**

We have stressed the importance of *direct* marginal costs in fixing prices in transport : all differences of speed, user of the available capacity, distance, types of goods, vehicles, days and season, route, etc., may modify the costs and consequently the prices. We will mention two particularly important cases as an example :

1) *Tariffs based on the distance.* — As regards the demand, there is therefore no reason to require a higher price in the case of long distance transport than transport over small distances (see above under II, C. 3). However, as regards costs, there may be some reason for

doing this. However, to try and ascertain the cost of « one additional kilometre » is a sterile undertaking which may lead to errors. Another reason seems to us conclusive. If long distance transport was offered at the same price as short distance transport (single tariff), the geographical distribution of production and consumption would be completely modified : long distance transport would increase and the weight of short distance transport decline. Consequently, the demand for transport services and the cost of transport would increase. The increase in the transport price with the distance fights against such an increase in the demand for transport and in its cost. From the point of view of cost, a transport undertaking derives an advantage from making long distance traffic pay more than short distance traffic. The advantage is the greater the more extensive the system (1).

Should the price of transport increase with the distance in a proportional manner, either up or down ? An analysis of the costs shows that in general a decreasing tariff seems appropriate. The terminal costs which are independent of the distance represent in effect an important part of the total costs. In most cases, it is more advantageous for a transport undertaking to carry a single consignment 500 miles than 100 consignments 5 miles. A rational tariff drawn up with the object of making a profit must therefore take such differences of cost into account. This can be done by making a distinction in the tariff, between the consigning costs and a rate proportional to the distance, or else by adopting greatly reduced rates for long distances.

Should rates reduced according to the distance be adopted when the terminal costs have already been adequately taken into account in the consigning costs ? There is no set reply to this question; the special characteristics of the system in question are the determining factors.

2) *Quantity rebates.* — Quantity rebates give rise to similar considerations. What involves a transport undertaking in costs is first of all the movement of its own vehicles, whether loaded or empty. The supplementary costs for a million kilometric tons will therefore be the smaller as the vehicle-kilometres are the lower. Therefore, the decisive marginal costs from the point of view of the price policy will be the smaller, the better the vehicles are used. Consequently, the tariffs must be reduced as a function of the user of the available capacity. To do this, quantity rebates must in fact be offered. (In addition, a study should be made to see whether inevitable light runs should be taken into account in the tariffs.)

As soon as the indirect costs begin to come into the picture side by side with the direct marginal costs, things become more complicated. Two oher examples will show this :

3) *Linked products.* — There is an

(1) On a small system, this advantage may be much reduced. For example, no one is ready to cross a large town several times a day unless they have the time. A gradation of the tariff would therefore have little effect upon the demand. Consequently, a metropolitan railway has no great interest in differentiating its prices as a function of the distance.

empirical rule in the case of maritime transport, accompanied it is true by numerous exceptions : « Freights shall be the higher in the one direction as demand is lower in the other direction, so that the freight rates for the two directions vary inversely » (1). Transport in the two directions, for example from the Channel ports to South America and vice versa are linked products for the ship companies, so that a decline in the volume to be carried in one direction increases the marginal costs and consequently the price in the other direction.

4) *Alternative products.* — As the different trains on a given line are alternative products, the marginal costs will be higher on lines already having a considerable traffic than on lines whose capacity is less well used. Consequently, it might be wise to differentiate the prices as a function of the density of traffic or more accurately according to the degree of user of the capaciy of the line (2).

In a very general way, differentiating the prices of transport as a function of the costs (marginal) contributes towards reducing the total cost for the transport. This differentiation of prices is therefore not only useful when it is question of making a profit, but also fulfils an important function from the point of view of the national economy. When we get the impression that the volume of transport needed by a given economy is exaggerated, we must ask ourselves first of all if the tariffs do not take into account the differences in the marginal costs to a sufficient extent.

CONCLUSION.

In the foregoing discussion, we have made abstraction of the costs due to the increasing differentiation, the dividing up, the refinement and the complication of the tariff system. We have admitted that the most bizarre confusion in rates presents no inconvenience relatively to the application of a single price. We have admitted that the transport undertaking should take into account, by a differentiation of price, all differences in the sensitivity of demand, and all differences in costs; as why should it not do so if this differentiation does not cost anything ?

In reality, the cost of differentiation of prices is not insignificant. We have only to think of the cost of getting out and printing the voluminous tariffs, the continual modifications thereto, the cost due to loss of time and mistakes in using them and the extremely costly results of putting the public in a bad temper from losing time and money and their dislike of constant changes in the tariffs, the instability of the tariffs, the concessions granted to certain persons or regions, etc. The history of the American Railways in the 19th. Century seems to show that

(1) LEWIS : « Overhead Costs », London, 1949, p. 96.

(2) However, the opposite argument is sometimes heard : « The costs are spread over more units, the better the user of the available capacity; consequently the unit cost is reduced. To take the cost into account, the prices should therefore be lowered on well used routes and raised on poorly used one. » In this argument, it is forgotten that it is not a question of allocated average costs. Only the supplementary costs or savings, which depend upon a modification of the tariffs, are determining factors (see above, under C I 4).

exaggerated individualism of the tariffs, far from resulting in higher profits, makes it impossible to achieve any reasonable prices policy and presents all the drawbacks of an oriental bazaar. Certain legal regulations have been added to these drawbacks : the forbidding of rebates and other limitations to the differentiation of prices imposed by the obligation to obtain legal ratification of the tariffs. Like numerous other branches of the public economy, the transport undertakings are giving up taking into account the numerous differences in demand and cost in their prices policy; they are accustomed to dealing in the same manner with services having altogether different marginal costs and partial markets working in quite different ways. They fix identical prices for identical distances, whatever the route; they do not apply different prices according to the time of day or season. In such cases, we might call it a generalised prices policy or a grouped prices policy (in contradistinction to a differentiated prices policy according to demand and specialised according to costs).

A grouped prices policy presents two problems : apart from legal obligations in the matter, what differences in costs and demand are to be taken into account in fixing the prices ? What services can be grouped together to be dealt with in an identical manner (« formal » tariffs) ? On the other hand, it is necessary to determine the price level to be applied in each group or each class of tariffs (« material » tariffs). A complete solution to the problem of grouped prices requires the formal and material problems to be dealt with in close liaison.

The second of these two problems may be solved today. In fact, all the rules given above for particular transport services can be applied without difficulty to the classes of tariffs in question. On the other hand, there are no rules as yet for formal tariffs. We can only repeat a very banal truth : several different transport services must be combined into a single tariff class if the advantages offered by so doing are greater than the drawbacks entailed. The theory of prices cannot offer any guidance in the matter. We will therefore conclude our summary by calling to mind the fact that a great deal still remains to be done.

April 1958.

[625 .285 (485)]

The KLL-Express.

Swedish light metal train,

by Erik Aspenberg, Linköping.

(*Eisenbahntechnische Rundschau*, No. 9, September 1957.)

Following the trend toward modern, comfortable, light weight passenger cars, Swedish engineers have designed a short and low type of coach, several prototypes of which have been tested for their running characteristics under actual operating conditions. The following article deals with the principles to be considered for the design of this type of railway vehicles, the locomotives required, the special features of the cars, such as the running gear, and tells about the results of test runs.

POSITION OF THE PROBLEM.

There is no doubt that railway passenger traffic has suffered severe losses through the competition of other methods of transport, especially the automobile. The number of passengers who make use of the trains, especially for short runs and on the secondary lines through sparsely populated districts, has greatly declined. Consequently, at the present time, it is the long distance traffic which should procure the best financial returns for the railway. In Sweden the transport of passengers by ordinary or express trains for distances of 100 km (62 miles) and over is in fact the essential economic basis of the whole of the passenger traffic.

Throughout the world, railways are finding themselves faced with this same problem of conserving and improving their financial strength. Its solution is helped by making railway travel as attractive as possible to the passenger and offering him fast, comfortable, up-to-date transport at the lowest possible rates. All efforts tend above all towards the development and improvement of the long distance traffic, and many methods have already been tried to increase its competitive power. The undoubted advantage of the private vehicle, freedom to choose the hour of departure by the driver and his travelling companion can, for example, undoubtedly be effectively combatted by running small additional express services. Special stress must be laid on the features of railway travel: high speeds, punctuality, comfort, together with the possibility of having a meal, or making use of a couchette or sleeping berth.

Whathever methods are adopted to increase the traffic and obtain higher receipts, the question of the vehicles used is and must be of capital importance. What economic considerations would make advisable today is impossible in many cases by the very nature of railway vehicles, so that it is not possible to give the public the fast trains of average length with up-to-date interior arrangements for which they are asking more and more. The principal dimensions fixed for railway vehicles and their arrangement has been unchanged for many years and leads to heavy and costly vehicles. If the level of perfection attained with other methods of transport is compared with an ordinary passenger train, it is not possible to claim that the train is an example of the most recent progress. The objective should be to make faster, lighter and more attractive passenger trains at a lower cost.

Important technical considerations also favour the adoption of new ideas in the construction of railway vehicles. Each method of transport should be adapted to

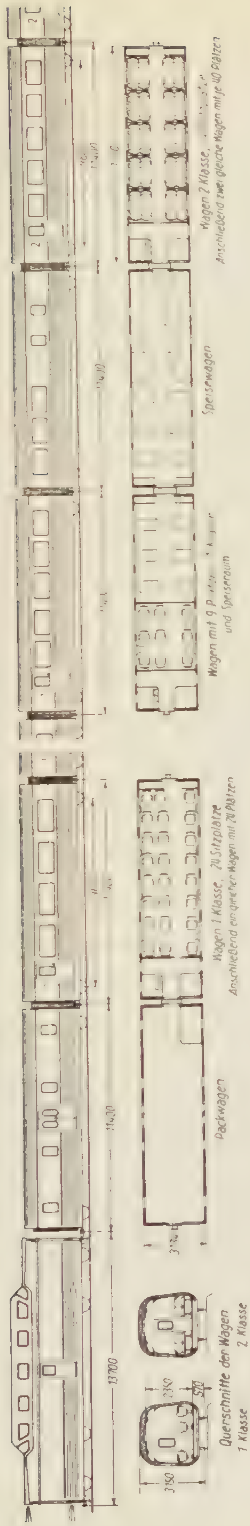


Fig. 1. — Longitudinal, in section and in plan, view of the KLL-Express made up of 10 coaches, with locomotive.

N. B. — Querschnitt der Wagen = transversal section of coaches. Packwagen = van. Wagen 1. Klasse... = First class coach with 24 seats. Follows an identical coach with 24 seats. — Wagen mit 9 plätzen... = coach with 9 1st class seats and restaurant compartment. — Speisewagen = restaurant car. — Wagen 2. Klasse... = 2nd class coach, 40 seats. Following 2 identical coaches with 40 seats each.

the special characteristics of the commodity to be carried. If we look upon the passenger as one such commodity, it can truthfully be said that it is a bulky commodity, the more so as the more space is allowed per passenger. Consequently, the draughtsman should pay particular attention to the weight of the vehicle. The usual weight per seat at the present time could be appreciably reduced without any harmful effects upon running quality and safety. It is therefore possible and necessary to design definitely lighter railway vehicles, in order to obtain tangible results therefrom. The wear of the wheels, the bearings and other moving parts would be less, the construction of the coaches takes less materials, and purchase costs may be reduced. The train load being reduced, the locomotive may be lighter and consequently cheaper. The reduction in the axle loads has fortunate repercussions upon the wear and maintenance of the track.

One particularly out-of-date feature of the present coaches is their relatively high floor level. On the Swedish State Railways, most of the platforms are 380 mm (14.96 in.) above rail level. Coaches should therefore be designed within one step of acceptable dimensions sufficient to bridge the difference in level between the platform and floor. With the present coaches, the passenger has to climb up three high steps which are not very convenient.

TRIALS IN OTHER COUNTRIES.

The above considerations led to the designing of a series of new types of vehicles which have all undergone trials in other countries. The first example of these is the Talgo train put into service in Spain in 1950, and the similar articulated automotor German train built in 1953, as well as the American versions of the Talgo train, the « X Train » and the « Aerotrain ». The common features of all these trains are : reduced weight, low height of the vehicles, low centre of gravity, and in addition considerably reduced length of the passenger coaches in order to make it

easier to solve the problems arising from the design and facilitate manufacture.

THE SWEDISH KLL-EXPRESS.

Bases of the project.

The trains of this type designed in other countries are exclusively trains of fixed and invariable length; they consist of several passenger coaches forming a permanent unit. In certain cases, these trains can only run in one direction. These drawbacks make it difficult to shunt the trains in the stations, make it impossible to meet any demands of the operating department requiring modification of the length and composition of the trains, and make the question of turning them round at dead-end stations a serious problem. In the review *Teknisk Tidskrift,* No. 3, 1952, there was published a project for building a train based in a general way upon the technical characteristics of trains of this type built in other countries, but avoiding the above mentioned drawbacks. The train was designed essentially to meet Swedish conditions. Its coaches are short, low and light. The initials of the Swedish words — kort, lag and latt — gave this design its name : KLL-Express.

The KLL-Express is made up of single coaches coupled together by a central automatic coupling. Each coach of the train in question has two axles, or rather four wheels, turning freely in pairs on a rigid axle. The different coaches can be coupled up or uncoupled at will, and can run in both directions. All the coaches have the same leading dimensions and can be fitted out as day coaches or sleeping cars — with a division into classes corresponding to the needs of each particular case — mail coaches, luggage vans, etc. The train is coupled up to a specially suitable locomotive.

The general design of the KLL-Express was given to the « A. B. Svenska Järnvägsverksätderna », Linköping works. After a very thorough study of the projects, they decided to build three prototype coaches which were completed in January 1956 and put under trial in specially composed trains of the Swedish State Railways. The construction of these coaches had as its main object to make a thorough trial of the running gear, suspension and brakes. These parts were therefore fully finished, whilst the body only consisted of a metal framework and outer doors without any interior finish. To obtain the calculated tare, use was made of ballast of a weight correspond-

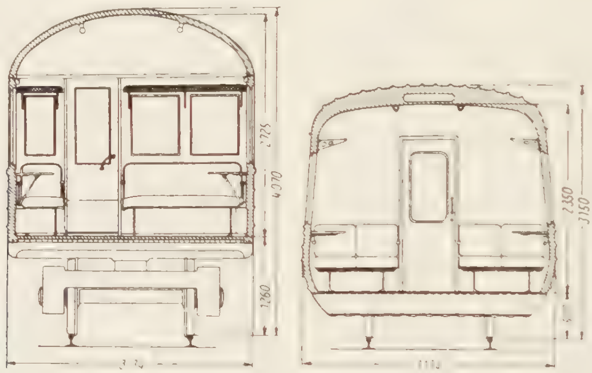


Fig. 2. — Comparison of the transversal sections of an ordinary express coach and a KLL coach.

ing to the missing fittings. One coach, whose running qualities was the subject of a special study was given an additional quantity of ballast corresponding to the weight of the passengers, placed at the exact level of the centre of gravity.

As the coaches were not fitted with the usual buffing and drawgear, but with central couplings, a special type of wagon fitted with the two types of coupling was used during the trials between the KLL coaches and the locomotive.

General particulars relative to the KLL coaches.

The KLL coaches are very unlike the usual passenger coaches on account of their particularly low and light design (fig. 2). The leading dimensions and weights show this very clearly :

	KLL coach	*Express coach*
	present 2nd class	
Length over buffers	11.4 m (37.4 ft)	23.5 m (77.1 ft)
Width of the coach	3.14 m (10.3 ft)	3.14 m (10.3 ft)
Height of coach above rail level	3.15 m (10.33 ft)	4.07 m (13.35 ft)
Height of floor above rail level	0.57 m (1.87 ft)	1.26 m (4.03 ft)
Height of centre of gravity above rail level	1.1 m (3.60 ft)	1.9 m (6.23 ft)
Tare of the coach	9 t	39 t
Number of seats	40	78
Weight per seat	225 kg	500 kg

The low entrance height, the greatly lowered centre of gravity and considerable improvement in the weight per seat which is less than half that of the old metal coaches, will be noticed in particular. All these qualities must be considered essential in designing modern coaches.

The body of the coach.

The body consists of a steel framework of main members with a spot welded outer casing giving a smooth exterior to the vehicle. The longitudes are arranged at the bottom of the body and below the curved roof and in conjunction with the shell stiffen the vehicle to such an extent that it can withstand thrusts of 150 t. The ends are strengthened by lateral stiffeners which distribute any possible shearing loads between the lateral braces.

The three prototype coaches are absolutely identical in construction. For each type of KLL coach the same body framework is used, apart from the dimensions of the windows, the wall covering, etc. (fig. 3 and 4). So far only the bare frame has been the subject of trials, putting off till later the interior arrangement, as the fittings as well as other components will naturally be different from those used in the ordinary coaches; however they will not give rise to any particularly difficult technical problems. Naturally, the coaches will be equipped with every possible convenience as regards the interior arrangement, the heating and ventilation, the lighting and sound proofing.

Running gear.

The specially remarkable part of the new type of coach is the running gear — axles, wheels and brake — as well as the suspension and coupling designed for these coaches (fig. 5 and 6). With a wheelbase of 9.6 m (31.49 ft.) and the resulting risk of derailment on curves owing to the wheel riding up on the rail, the fitting of axle guides was essential. The wheels are therefore fitted on tubular carrying axles, which do not turn. These axles are connected together by means of a longitudinal tube and form a whole with the central coupling. When two coaches are coupled together, and as the central couplings used

Fig. 3. — The three prototype coaches during a trial on the line in the spring of 1956.

Fig. 4. — The prototype KLL coaches at a platform.

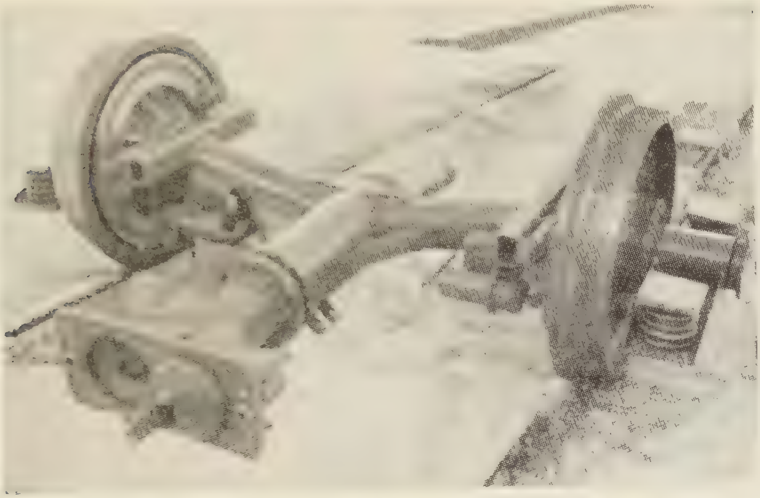


Fig. 5. — KLL running gear with central coupling and brake rigging included.

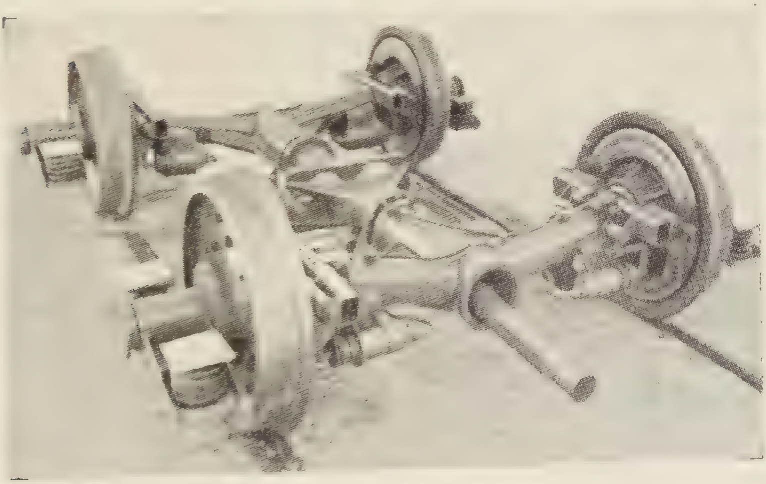


Fig. 6. — Coupled running gear.

for this purpose have very little play, the pairs of axles assembled in this way form a bogie of the ordinary type. Each end of the coach thus rests on its own running gear, by means of rubber buffers fitted outside the wheels, and each bogie formed of two running gears automatically inscribes itself to the curvature of the track when running through curves (fig. 7). The tractive and compression stresses arising between the coaches are transmitted to a rod fixed at one of its ends to the centre

and back of the coupling, and at the other to the frame of the body beyond the running gear. As a result the tractive and compression efforts are not transmitted to the running gear.

The locomotive is coupled up in the same way to the front running gear of the first coach. For this purpose, in the case of a bogie locomotive, the bogie frame, or any other part showing the minimum transversal displacement during running is fitted with a traction bar equipped with the KLL central coupling. Very smooth running is obtained in this way, and the leading axle of the first coach follows the curve almost exactly without any hunting movements.

The last axle of the rake runs freely without the wheels being guided. In this case it is necessary to use an axle without guide because this axle always remains perpendicular to the axis of the coach and when running through a curve all the wheels always attack the rail from a negative angle. This carrying axle is kept in place by the rubber buffers on which the body rests outside the wheels, the rubber buffers exercising a powerful recall action which prevents any horizontal movement of the axle. If necessary, shock absorbers can also be provided to damp out these oscillations. To assure that the last pair of wheels will run smoothly, the brake is put out of circuit by means of an isolating valve connected mechanically to the isolating valve of the ordinary brake pipe, fitted at the two ends of each coach.

The cranked carrying axles are at such a low level in the centre of the coach that the whole floor of the coach can be arranged at the same height. The wheels, turning in SKF conical roller bearings have a diameter on the tread of 680 mm (2.23 ft.) only; where they project above the floor, they are covered with steel plates (fig. 8 and 9).

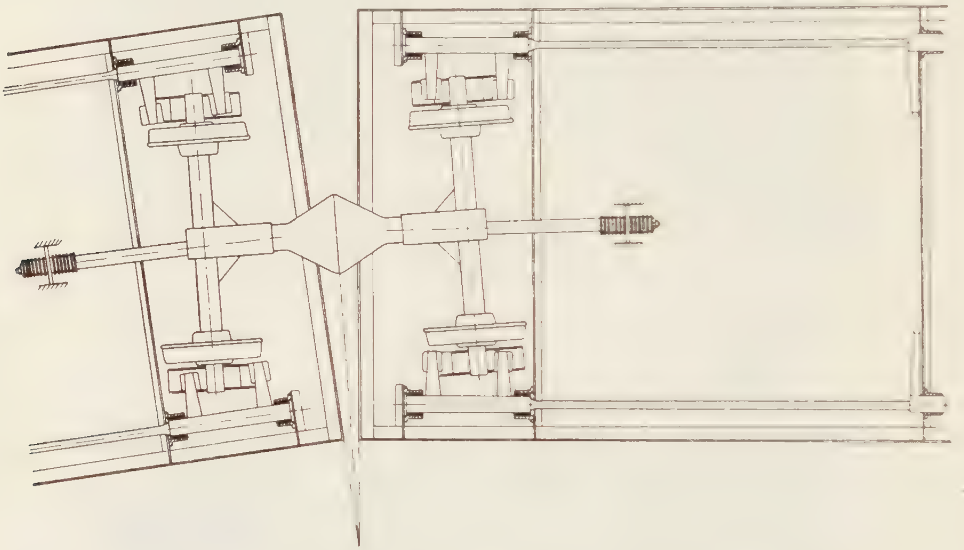


Fig. 7. — The suspension of the KLL running gear and its position on a curve.

The brake system.

The coaches are equipped with Knorr type KE compressed air brakes, in other words with a standard modern pattern which can be used on all railway vehicles.

The braking effort is exerted by a unilateral disc brake, the disc of which is fixed to the inside of the wheel. When the brake is applied, two brake linings are applied from both ends of the axle against the disc. Each of these linings is applied by one brake cylinder, so that the rigging between the cylinder and the lining is extremely simple. On each coach, one pair of wheels is also fitted with a hand brake acting on the braking disc.

The arrangements used on these coaches also make it possible to fit magnetic rail brakes, but it is not proposed to do so at present.

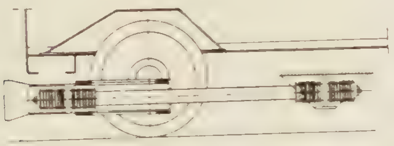


Fig. 8. — Longitudinal section of the KLL running gear showing the arrangement of the traction bar.

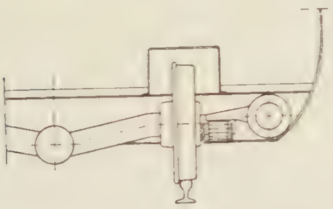


Fig. 9. — KLL running gear.

The suspension.

The body rests on rubber springs and coiled springs (fig. 7). On the part of the axle beyond the wheels, there is a beam arranged in the longitudinal sense, at the ends of which there are two high rubber springs. These springs are responsible not only for the vertical suspension of the body, but also for damping out any oscillations of the wheels due to running through curves on the line, as well as transversal displacements between the running gear and the body.

On each rubber block there rests the end of an arm perpendicular to the longitudinal axis of the coach, the other end of which is fixed to a sleeve mounted on rubber in the frame. One end of this sleeve is connected to a spring with torsion bar arranged along the longitudinal axis of the coach, whilst the other end is fixed to the frame of the coach. With this method of fixing, the torsion spring can be relatively long and consequently the stresses set up in it remain small. The torsion bar spring is adjustable in its mounting upon the frame, so that the height of the floor can be adapted to requirements. However, it has been given sufficient movement for the weight of the coach and for any difference in dimensions occurring during manufacture.

The coupling.

The principle followed in designing this train, consisting of coupling up the coaches by means of couplings fastening to the running gear resulted in it being unnecessary to provide any special coupling on the actual body. The design of the body is considerably facilitated because the point at which it was decided to fasten the coupling is a certain distance beyond the running gear where the damping out and distribution of the traction and compression stresses are an easy matter. The couplings themselves have to have as little play as possible and be connected as tightly as possible together. The usual couplings therefore have to be made with particular care for these coaches. In addition, these couplings can turn one upon the other to a limited extent according to the longitudinal axis of the coach in order to make up differences in level between the four wheels forming the double coupled running gear.

Independently of this, the central coupling also has the advantage of being able to be coupled up at the same time as the compressed air pipes and electrical connections, making it unnecessary to have special connections between the coaches.

THE LOCOMOTIVE.

As these are light weight coaches, the locomotive can also be a light one. Compared with the classic passenger train, even with an equal number of passengers, much lower power is required. Like the coaches the locomotive has to have as low a centre of gravity as possible. This result can be obtained in various ways; one rational system is to adopt a bogie locomotive. The four axles are driven by two motors mounted longitudinally, each motor acting on one bogie by means of cardan shafts and conical gears. This arrangement is applicable to Diesel locomotives as well as electric locomotives. On the Diesel locomotives, the torque is transmitted to the axles by means of a hydraulic drive.

The locomotive has to carry certain auxiliary installations which differ from the classic installations for supplying the train with electric power by the various innovations which can be made in the case of trains of an entirely new type. So far each coach has had its own installation for generating electricity for lighting, usually 24 V D.C. The 16 $^2/_3$ Hz 1 000 V current needed for heating was supplied by a generator on the locomotive; in the case of steam trains, steam was used. These solutions have a great many drawbacks. For example the source of current for the lighting is not very powerful; it is heavy and costly to buy and maintain. The heating current involves fitting special cables the whole length of the rake, in order to avoid the formation of arcs as well as damage. Obviously, the arrangements that this involves are heavy and in addition expensive. The motors, for example the motors for the fans which have to be supplied from these sources of current, have to be specially designed, or if they are of a standard type, involve using a transformer which in its turn is heavy and expensive. The locomotive provided for the KLL-Express can therefore be equipped with an installation for generating the auxiliary current which is suitable for an up-to-date lighting and heating system.

LIGHTING AND HEATING OF THE RAKE.

A converter group has to be installed on the locomotive of the KLL-Express producing 50 Hz 380/220 V A.C. and supplying the whole of the power needed to light and supply the motors of the complete rake. In addition, each coach is equipped with a small battery charged with three phase current by means of a rectifier; this assures the emergency lighting which has to be used in certain cases, for example when the locomotive is not coupled up. As 50 Hz 220 V current is available, the wiring and equipment can all be of standard types and consequently of the ordinary cheap kind; the motors can be squirrel cage type motors, etc.

In the case of the KLL-Express rakes running on electrified lines, the heating current can be supplied by the main transformer of the locomotive. In this case again, the current has a voltage suitable for ordinary standard radiators, really 220 V but can also be 380 V in order to make it possible to use standard equipment. Obviously, the current is sent through the heating batteries in order to supply the rake with hot air and the local heating equipment — in the form of electric radiators — is only used in very exceptional cases.

When the KLL-Express is hauled by a Diesel locomotive, hot air heating is also used. This is produced by oil fired heating equipment designed as heat exchangers; the hot air is mixed with fresh air which serves to renew the air and arrives inside the coaches in the usual way.

COMPOSITION OF THE KLL-EXPRESS.

Provision has been made for different sizes of KLL rakes; the most frequent composition will be 10 coaches, offering 265 seats, weighing in all, locomotive included, 126 t (fig. 1). Of these 10 coaches, two will be arranged entirely or partly as restaurant-cars; if necessary a luggage van can also be put behind the locomotive.

The following table makes it possible to compare a KKL rake of this type with the « Gothenburger » which runs daily between Stockholm and Gothenburg. The power of the KLL locomotive is essentially function of the tractive effort required to climb a gradient of 1 : 200 and at the same time overcome the air resistance corresponding to a speed of 150 km (93 miles)/h.

During the first runs, the dynamic stresses in various parts of the running gear were measured by means of detecting extensometers, amplifiers and recording equipment. These measurements led to certain reinforcements being made at certain unimportant points of the carrying axle. In addition the vertical acceleration of the non-suspended carrying axles was

TABLE. — **Comparative values for an ordinary type express and a KLL train of the same capacity.**

	«Gothenburger»	*KLL-Express*
Maximum speed	130 km/h	150 km/h
Weight of the locomotive	60.8 t	35 t
Power of the locomotive	3 300 HP	1 400 HP
Number of coaches	5	10
Seats in the passenger compartments	267	265
of which : first class	96	105
second class	171	160
Restaurant seats	48	46
Weight of the rake, locomotive and coaches	228.1 t	126 t
Useful load	23 t	23 t
Total weight, useful load included	251.1 t	149 t
Ratio of useful load to weight of the rake	10.1 %	18.3 %
Weight per seat (weight of rake per seat)	875 kg	475 kg

RESULTS OF RUNNING TRIALS WITH THE FIRST KLL COACHES.

The first three prototype experimental KLL coaches were completed in January 1956. Thanks to the good offices of the Swedish State Railways a series of running trials was then carried out. The running qualities of the coaches proved from the beginning so good that after a few runs the speed was increased to 120 km (74 miles)/h.

measured by means of accelerometers. Average values of 20 to 30 m/sec^2 were recorded with a maximum, rarely reached, of 50 m/sec^2. It should be noted that above 60 km (36 miles)/h, this acceleration remained practically independent of the speed of the vehicle. Its low value, compared with that of coaches with higher axle loads deserves to be mentioned.

Other trials were devoted to the general running qualities and horizontal and vertical movements of the body of the coaches. It was found that the coaches ran very

smoothly. No oscillations due to the track (for example hunting oscillations) were noted. The accelerations of the horizontal movements above the running gear remained on the average between 0.3 and 0.5 m/sec^2. No improvements had to be made in this connection; however, naturally various arrangements of elements likely to damp out the transversal stresses were also given a trial.

The deflection of the springs under full load amounts to about 235 mm. The coach thus undergoes vertical movements which should be considered normal for coaches with ordinary bogies. In addition certain oscillations occurred of a frequency of about 2 Hz and a maximum acceleration of 0.75 m/sec^2. When steps were taken to eliminate or reduce these oscillations, it became apparent that the friction of the torsion bar springs in the sleeves was of capital importance. Owing to this friction, the total vertical deflection was damped out to some extent, but this must not be too great. With an assembly without friction of the torsion bar sleeve and a hydraulic damping out of the vertical movement, the vertical acceleration was reduced to about 0.4 m/sec^2. At the same time the frequency of the vertical oscillations was greatly reduced. The value of 0.4 m/sec^2 was recorded above the running gear; near the middle of the coach the movements became smoother. These results correspond with the best results given by the best bogie coaches on the Swedish lines, which lines are not particularly good.

According to the trials carried out to date, the KLL coaches at all speeds have running qualities which will enable them to compete favourably with vehicles of former types. The simplicity of the design, the suspension and functioning of the running gear, the light weight, the modern appearance and arrangement, all go to prove that the KLL train will be invaluable in the future for the fast and express trains.

[656 .212 (73)

Central opens young yard.

(*Railway Signaling and Communications*, March 1958.)

Named for Chairman Robert R. Young, the New York Central's newest retarder classification yards at Elkhart, Ind., will cost a little over $14 million. Replacing 12 other yards, it will cut freight car time through yards from 20 hr 29 min to 8 hr 49 min. Technical advances include the largest electronic analog computer devoted exclusively to control purposes, these being automatic control of retarders. Automatic programmed switching uses a magnetic core memory capable of storing classification information on 150-car trains. If cars stop short on classification tracks, a remotely controlled machine, known as a car accelerator can shove them to clearance. Television will be used to grab car numbers of inbound trains, and recorders used for number grabbing for outbound trains. Communications everywhere will include paging and talk-back speakers as well as radio. Car inspectors will use dual-channel walkie-talkies, and skatemen will use Dick Tracy radio transmitters operating in conjunction with paging loudspeakers.

In its efforts to improve service to shippers and reduce operating expenses, the new Robert R. Young yard at Elkhart, Ind., represents the application of the latest techniques of automation to the classification of freight cars, as well as being in a « natural » location. A look at the map shows Elkhart about 100 miles east of Chicago on the mainline to Toledo, Cleveland and New York. Other Central lines pertinent to the Elkhart story include Detroit-Niles-Porter with connections to the Indiana Harbor Belt at Gibson; a line to Joliet; a line west from South Bend to Kankakee (Kankakee belt line) with connections to western railroads; and a line from Elkhart, north and east to Jackson, Mich. Elkhart was a major classification point on the mainline for east-west traffic. Niles, Mich., was a classification point on the northern district for east-west traffic on the Detroit-Porter line.

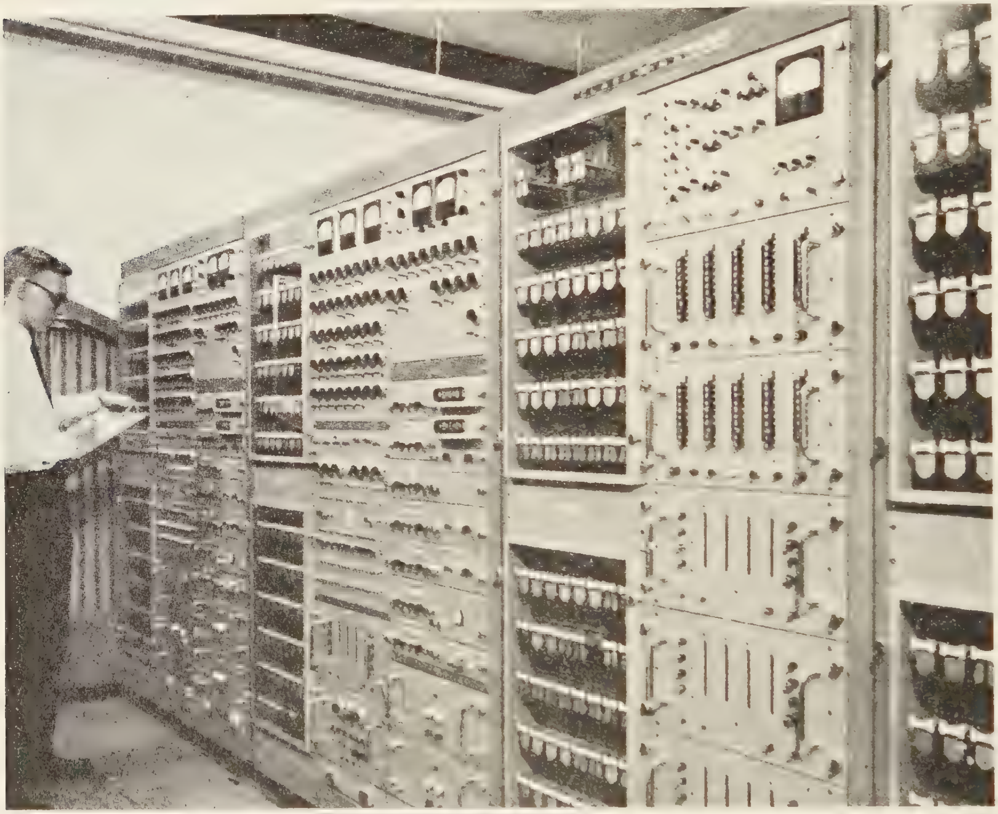
Traffic studies showed Elkhart receiving 15 trains from the west and 13 from the east for classification, and Niles receiving 12 trains from the west and 8 from the east. Time for a car through Elkhart was 24 hr 24 min, and through Niles was 16 hr 23 min. Elkhart classified 1 328 cars daily (an average) and Niles handled 1 163 cars daily, this work being handled in flat switching yards.

Why not one yard for classification?

This question naturally came to mind as the Central management studied the situation. Certainly a modern retarder classification yard would reduce time spent by cars in the yards, give the shippers better service, and reduce operating expenses. If one new yard could handle the traffic where would it be located? Of the various sites possible, Elkhart appeared to be the best suited, not only traffic-wise, but the railroad had a 675-acre plot west of the passenger station which would « fill the bill nicely ».

Redispatching studies were made, realizing that track and signal changes would be necessary to handle the traffic efficiently in and out of Elkhart. Westbound traffic from Detroit would be moved over a new or rebuilt Jackson-Elkhart line. Chicago-Detroit eastbound freights would move over the mainline, Chicago to Elkhart, and then after classification, would go via Jackson. These studies revealed that there would be

considerably less traffic on the Jackson-Porter section of the Detroit-Chicago line. This led to the decision to take up one main track of this double-track line and install centralized traffic control. To handle traffic over the rehabilitated Jackson-Elkhart line, centralized traffic control was installed on this single-track with five, controlled sidings. Another advantage of the new yard would be the finer classification of cars with the resulting reduction in switching and blocking of cars at other yards, such as Englewood (Chicago), Gibson, Ind., Blue Island, Ill., Kankakee, Detroit and Toledo.



Electronic analog computers calculate the speed at which cars should be released from retarders. The master retarder and each group retarder has its own analog computer.

What does young yard replace?

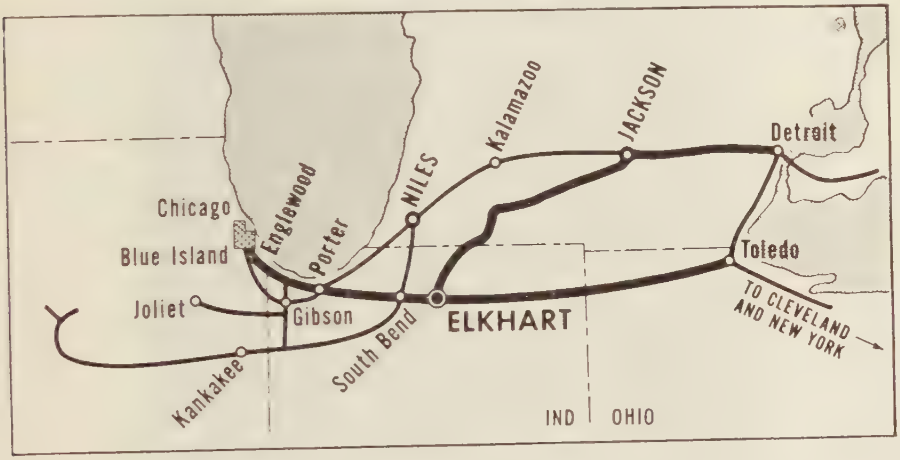
This new yard eliminates Niles as a classification point. Three yards here, totaling 59 tracks with 5 273 cars capacity, are to be replaced with a 16-track local yard of 720 cars capacity. Engine servicing, car cleaning and repair tracks and facilities are to be eliminated. At Elkhart, nine yards totaling 81 tracks with 5 112 cars are to be eliminated. Engine servicing facilities are to be re-established at the new yard site. Changing the Jackson-Porter double-track line to single-track with CTC will involve discontinuance of 10 interlocking

stations, and 143 miles of second main track. The new Elkhart-Jackson route involves rehabilitating 97.5 miles of old line.

The following benefits are obtained by constructing a new modern retarder classification yard at Elkhart, Ind. :

Two freight terminals are consolidated;

Modern switching facilities reduce switching facilities at other yards;



Concentration of operations produces peak utilization of yard engines and road power;

New route reduces train-miles (Jackson-Elkhart connection);

Operation of through tonnage trains is facilitated;

Equipment and lading damage reduced by use of automatic switching and retarding controls;

Valuable real estate becomes available for industrial development at Niles and Elkhart;

Car detention is reduced and service to shippers is improved by 24-hr daily operation of car repair facilities;

Service to shippers improved by more efficient classification of cars in the new yard.

What's at the new yard ?

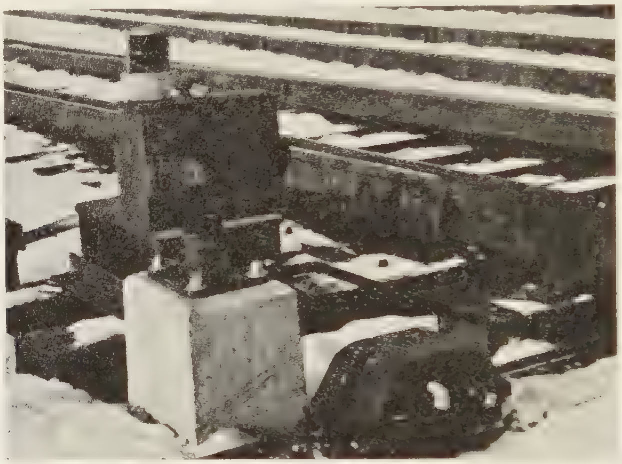
The new Young yard is about four miles long, parallel to and south of the mainline about a mile west of the Elkhart passenger station. This yard is the in-line type with the receiving yard (15 tracks, 1 954 cars) at the east, followed by the classification tracks (72 tracks, 3 540 cars). Parallel to these are the departure yards eastbound (5 tracks, 750 cars) to the north, and westbound (6 tracks, 900 cars) to the south. Eleven of the receiving tracks can handle 150 or more cars. A running track in the eastbound departure yard, as well as an « Early Bird » track (150 car-capacity) can be used for trains with prior classification which only have blocks of cars added or taken off at Elkhart. An 11-track local yard has 434 car-capacity. The classification yard consists of eight groups, nine tracks each. Tracks 1-36 are for eastbound blocks; 37-42 for Elkhart, Western locals and repairs; and 43-72 for westbound blocks. Typical classifications include New York City, Weehawken, Kalamazoo, East De-Witt, etc. Typical westbound classifications include C & EI Chicago Heights, six separate blocks for IHB yard at Gibson, and five separate blocks for Englewood. Two class tracks are assigned for repairs (rip track),

one track for holds (no bills) and one track to hold cars for cleaning.

Other facilities include a 200-car capacity repair area. The engine servicing facility will service road locomotives and also do the necessary inspection work for engines assigned to Elkhart. Two car-cleaning tracks of 95-car capacity are on the south side of the classification yard. Buildings include a hump general yard office with tower for the general yardmaster, terminal train-master, etc.; a hump conductor's office; retarder building with tower office for the retarder operator; west end yardmaster tower office and building; and the necessary buildings associated with the rip track and engines servicing facilities.

Trains arrive and depart with no delay.

Remote control interlockings at the yard entrances enable road trains to enter and leave the yard with no delay. These interlockings include the junction with the new route to Jackson, which leaves the mainline just east of Elkhart passenger station. As trains enter the receiving yard they move over GRS electric switchman machines, which are remotely controlled, by either of two switch tenders. A switch position signal shows lunar white for switch lined for the lead, and yellow for a diverging route. A red lamp atop the signal indicates stop. This light is illuminated when the switch points are in motion or if the switch does not complete movement. The control machine for these switches has a track model diagram with each switch represented by point indicator. When the switch tender controls a switch, he turns the indicator so that a solid white line 1/4 in. wide shows the route the train will take. A lucite button on each receiving yard track controls the yard track indicator. If the route is lined into a receiving track, pressing this button will control the yard track indicator to show the track number. Thus approaching enginemen know that the route is lined for them when they see the yard track indicator.



Non-interlocked switches on receiving yard leads are remotely controlled.

Automatic switching can be programmed.

The automatic switching system in this yard is unique in that each train to be

humped can be completely programmed in advance of humping operations. The heart of this ingenious GRS device is a ferrite core memory unit. A number of these memory units are employed to permit storing several trains ahead of time. When programmed, a given memory unit contains the class track assigned to each car in that train and will so hold this information until the cut is ready to be made.

The programming of the memory unit is entirely automatic. The switch list is prepared by a clerk in the yard office from a stack of IBM cards. These cards have been automatically made from a tape-to-card machine and initially contain information pertaining to railroad owner, car number, load or empty, type of car, and destination out of Elkhart. Local yard operations assign a class track number to the car represented by each card. This information is punched into the card by the clerk and the cards are then sorted into the order in which the cars will come over the hump. A Teletype tape is then prepared by running these cards through a card-to-tape machine. This tape is then inserted in a Teletype transmitter-distributor for transmission to various offices in the yard where it is received in page form. In addition, at the hump conductor's office the information is fed into the programming system which stores the switch list in the ferrite core memory unit.

Ferrite core stores switch list, then is taken from memory unit to read-out unit.

The programming system further contains facilities whereby changes made in the switch list can be programmed manually into the memory unit before the train is humped without affecting other information already stored in the memory. When the humping is ready to begin, the memory unit is plugged into the read-out system which feeds information to the automatic switching system, and the hump conductor

operates a key-switch from the « manual » to the « automatic » position. From that moment on, the class track number for each car in the train is fed automatically into the automatic switching system as the cars are cut off at the crest of the hump. The rate of advance of the cars over the hump governs the rate of advance of the read-out system, and thus, the application of the program to the automatic switching system.

Since each car in the train is programmed in the memory unit, it is necessary to consider the implications of a multiple-car cut. Only one or two-car cuts are being made in this yard. Since the switching system needs only the destination of the lead car of a two-car cut, the destination of the cut must be removed from the switching system to prevent the car following the two-car cut from taking this information. This is accomplished by holding in the initial storage of the switching system, the storage of the second car until the first car has passed through a test section. In this test section, it is determined whether the first car is alone or the second car is coupled to it. If the first car is alone, the storage for the second car is advanced into the automatic system. If the second car is coupled to the first car, the track destination for the second car is automatically canceled from the switching system.

It becomes necessary on occasion to change a class track number for a car from the class track programmed in the memory unit. For example, a bad-order car may be detected by the car inspectors. On such an occasion, the hump conductor moves the key switch from « automatic » to « hold » when the car to be changed is read into the initial storage in the switching system. The original destination is canceled manually, and the new track number inserted by operation of the appropriate track push-button. The key-switch is then returned to « automatic » and the humping proceeds without interruption.

A further advantage inherent in the ferrite memory unit lies in the ability to move to any point of storage in the device by simple push-button manipulation of the line number system. Read-out will take place at the chosen starting point. Thus if a group of cars has been removed from the train and appears at the end, for example, the memory can be operated to the point of discontinuity, reset at the new starting point, and finally returned to the « skipped » section when these cars appear at the end of the hump.

Automatic retarder control uses large electronic analog computer.

The distinguishing feature of the new automatic control system developed by GRS for Young Yard is the « fineness » of the degree of control obtainable in coupling speeds. After years of study and measurements GRS completed the design of the Class-Matic System now in service at Elkhart. The elaborate computations involved in the equations of motion used in the Class-Matic system are handled by precision analog computers. A separate analog computer is associated with the control system for each group retarder, and also, the master retarder.

Factors such as grade, and other physical constants in the yard are « set-in » to each computer by numerous control knobs. Factors pertaining to a particular cut such as weight, route to be taken, distance-to-go, etc., are switched into the group computer as the cut nears the group retarder. The analog computer « thinks » in terms of resistance and reference voltages. All of the above factors are therefore converted to analog computer language before being fed to the computer. The computer requires approximately 0.1 sec. to arrive at the precise speed which the cut should leave the group retarder to enable the cut to make a damage free coupling. It is the job of the automatic retarder control system to deliver the cut at the end of the retarder at the computed leaving speed within very close tolerances.

Test sections equipped with rail treadles are located at intervals ahead of the master and each group retarder for the purpose

of accurately measuring the speed of a cut as it rolls free. From these speed measurements, the computers calculate the ratio of friction to weight for each cut ahead of the master retarder, and again, ahead of each group retarder. This ratio is used to determine the computed release speed of each cut from the master retarder, and is one of many factors used to determine crest of the hump the car rolls down about 250 ft. of 3 % grade (over a 105 ft. electronic track scale) and onto the master retarder (4.15 % grade for 198 ft.), then onto 515-560 ft. of 0.93 %, 1.11 or 1.18 % grade on the various leads and through the group retarders. The tangent class tracks have a 0.15 % descending grade to the skating point. Then there is 400 ft.

Photocells « read » cut lengths (two cells one above other) and check car location.

the computed release speed from the group retarders.

Before Young Yard was placed in service on Jan. 10, the Central worked closely with GRS for approximately one month making test car runs into 45 of the 72 tracks in the yard. A special test train of ten cars was used and each of the ten cars were humped individually three times into each track which was tested. Treadles spaced along each body track were connected to special computing equipment in the tower for these test runs. The analysis of this test data enabled the GRS to set the yard factors into the control computer for each group.

Let's follow a car.

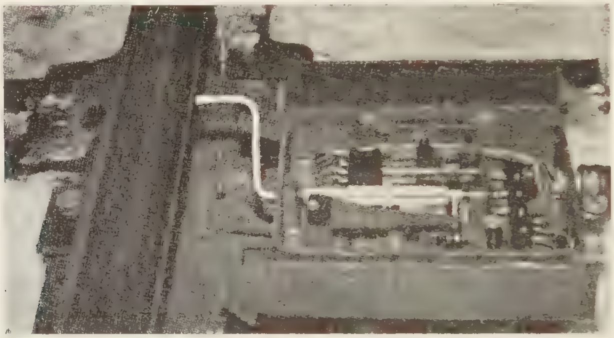
Now let's follow a car down the hump through to its final class track. From the of ascending grade ranging between .25 % and .35 %. Hand skates are placed and removed by skatemen.

As the car leaves the crest of the hump it passes the long-cut photocell located midway of the track scale. Information as to the length of the cut (in this case one car) is fed to the master retarder computer. Next the car's time is measured as it travels 34 ft. down the hump lead. A front wheel of the car depresses a treadle, which starts a five-digit counter. When the same front wheel depresses the second treadle 34 ft. further, the counter is stopped. The counter has registered a certain number of cycles from a 6.6 kc oscillator frequency. As this is a measure of the time the car traveled the 34 ft., the average velocity of the car over the 34 ft. distance is easily computed. Just beyond this first

set of treadles, the car passes through the photocell beam of the counter clearout photocell. When this beam is interrupted (car has passed) the counter information is dumped into relay storage and into the computer. When this beam is restored, the counter is reset for the next car or cut. This velocity VI of the car is calculated. Then after rolling a short distance, the front wheel of the car depresses another treadle, travels 34 ft. and depresses a second treadle. The time of passage of the car is timed by a second 5-digit counter. This count is transferred to the computer which calculates velocity V2. This, again, is average velocity over the 34 ft. distance.

Next, the car passes over a weight detector, which is a slot-in-the-rail device. Three micro-switches detect the weight as light, medium or heavy. This information is fed into this master retarder computer. The computer then calculates the speed at which the master retarder should release the car. The computer calculates the release speed for the car in about 1/10 of one second just before the car enters the master retarder it interrupts the entrance photocell of the master retarder. Restoration of this photocell beam releases the computer for the next car.

The master retarder consists of four 49-1/2 ft. sections which are individually controlled. Each section can be controlled to five different positions from open to closed.



Track treadle (with cover removed) depressed by car wheel starts or stops counter.

Radar enters here.

As our car entered the master retarder, it passed over a radar transmitter-receiver mounted between the rails. The radar is beamed down the hump toward the receding car. Operated on a frequency of 10 525 mc, the radar beam is reflected from the car. The difference between the outgoing and the reflected beam is used to determine the speed of the car. This is compared with the computer calculated release speed. The retarders are adjusted to the position such that the car will be released at the computer calculated speed.

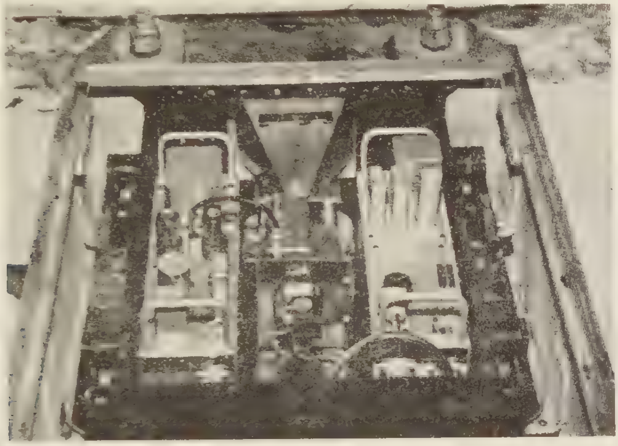
Realizing that the second half of the retarder is separately controlled, the computer calculated release speed was put into storage for transfer to the control system for the second half of the retarder. This transfer is made by our car's breaking and restoration of an intermediate photocell light beam at the midpoint of the master retarder. Restoration of this beam readies the first half of the master retarder control system for the following cut, and also, cuts in the radar unit covering the second half of the retarder. Thus this section of the

retarder can be properly positioned to release the car at the computed speed.

As the car leaves the master retarder, its weight and cut length pass into the transfer system feeding the group retarder analog computers. Restoration of the exit photocell beam readies the second half of the master retarder for the following cut.

mation from the automatic switching system, and the cut length and weight from the information transfer system. Impulse switch detector track circuits are used in the yard.

The computers operate continuously. When no car is in the system, a test problem is fed to each computer to check its answer against a calibrated standard. The



Radar unit (cover removed) measures speed of receding car (antenna in center).

Free rolling for 130 ft.

Our car now rolls at least 130 ft. before it encounters another set of rail treadles (54 ft. apart) for calculating velocity. Further on in approach to the group retarder, it passes over two more treadles 54 ft. apart. The group retarders are 115.5 ft. long with the exception of the two center groups which are on the shortest and straightest route from the master retarder. These center group retarders are 99 ft. long. As our car enters the group retarder, it passes over a radar unit which measures its speed through the retarder. Here again, breaking and restoration of an entering photocell light beam releases the computer for the following cut.

In addition to these measured speeds, the group computer receives the routing infor-

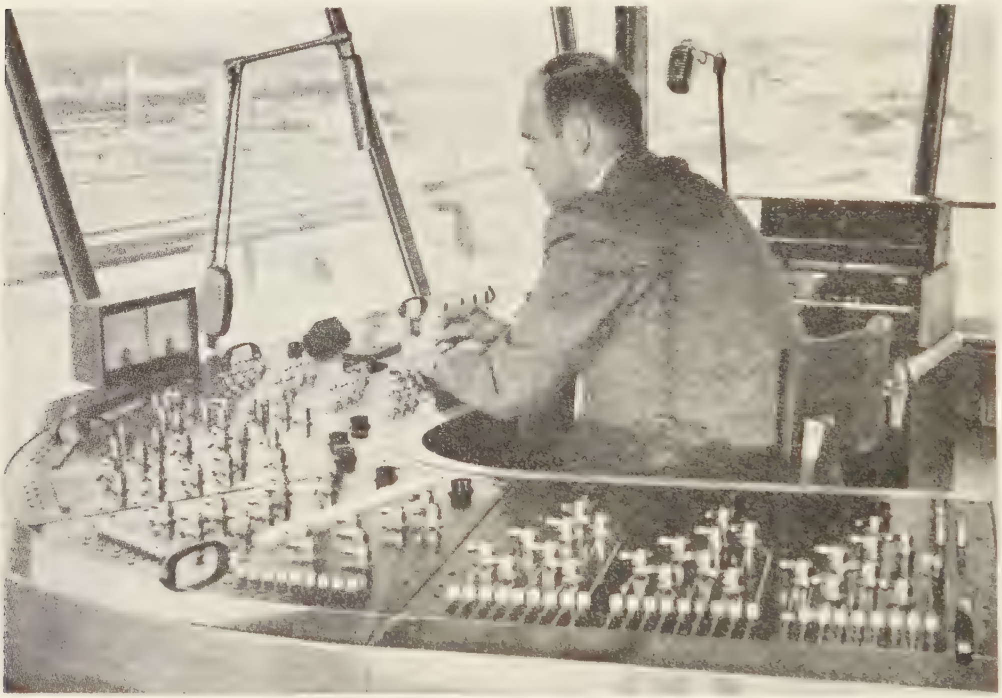
constant temperature and humidity in the room aid in keeping all resistors, tubes and other components within their adjusted operating tolerances. Blower fans are used to cool the computers.

All adjustments and the testing of the equipment can be done from the front of the computers. Switches, pushbuttons, potentiometers and meters are all « out in the open ». A special test board and patch panel enables any circuit functions to be checked without « getting inside » of the equipment.

The retarder control machine panel is similar to previous panels with conventional controls for the retarders and switches. Several new features have been added as part of the GRS Class-Matic yard controls. A lucite pushbutton with an indication lamp is located on each class track.

When the operator presses one of these lucite track buttons, a distance-to-go indicator consisting of a row of lucite pushbuttons is lighted to show the distance-to-go on that particular track These latter buttons show distance-to-go in car lengths from 2, 4, 6, 8, 10, 12, 16... and up to jumps of four to 72. By pressing one of the pushbuttons on the distance-to-go indicator, the operator can instantly reset or change the distance-to-go fed to the computer for that track. Distance-to-go is measured from two car lengths beyond the end of the group retarder. This measurement is kept up to date by a rail treadle which counts car wheels, four indicating a car. As car count information is fed into the computer, the distance-to-go is automatically decreased. The operator can « see » this action by observing his distance-to-go indicator from time to time.

When the track is pulled, he presses his track button followed by pressing the reset button, which puts the proper empty track distance-to-go back into the computer. The length of the various tracks is one of the factors originally « set in » in the computer. The retarder operator may have occasion to adjust distance-to-go as a result of a car stopping short on a class track as may occur when a hand brake is set. When this occurs, he presses the track button, which lights the row of distance-to-go buttons. He then presses the button that represents the corrected distance-to-go. This is registered in the computer, which functions as though the track was filled with cars up to the « short » car. Thus the retarder operator



Track fullness is shown by line of lights (by operator's elbow) on retarder control panel.

can prevent damage to lading by, in effect, telling the computer « don't send cars down fast on this track to drive the « short » car. »

Track fullness for each class track is registered in the hump yardmaster's office. Car count is indicated by mechanical counters which must be reset manually when a track is pulled. Thus, at a glance, the yardmaster knows how many cars he has in a class track. Above each counter is a plate with the car capacity of the track.

As a guide to the operator, two meters are on the panel, which can be switched to register for the master retarder or each of the eight group retarders. One meter shows the computed (release) speed in mph, and the other registers rolling resistance of the cut.

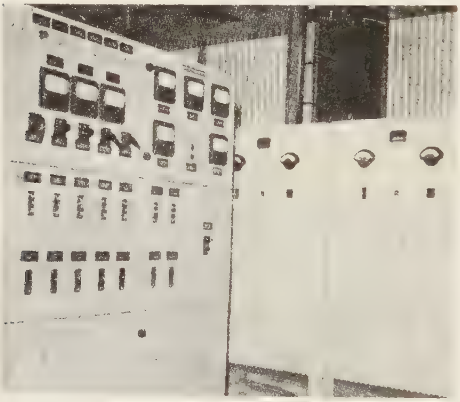
Meters registering wind direction and velocity are also provided, as is a thermometer outside the tower window. If the computer or some part of the automatic retarder control system is in doubt, a white indication lamp on the retarder control machine panel in approach to the master retarder or one of the group retarders flashes, and an audible alarm sounds notifying the operator, so he must apply manual control to the retarder involved.

Yard accelerator is unattended unit to push cars to clearance on class tracks.

Yard accelerator shoves cars.

If cars should stop short on a class track because of set brakes, the retarder operator can remotely control an unattended storage battery powered GRS Class-Matic accelerator to come down and push the cars to clearance or up to 10-car lengths beyond. Under these circumstances, the operator would notify the hump conductor and hump yardmaster, and receiving the « OK » would put the hump signal to stop. By manual control, he would open the retarders and line his class track switches. He would then

reverse the power switch at the accelerator spur track, just behind the hump crest. (Assuming, of course, that the hump engine had backed off with the train.) A dial on the retarder control machine panel controls the accelerator : stop; creep, 2 mph; slow, 4 mph; fast, 8 mph; back slow, 4 mph and 8 mph. Fast speeds can only be accomplished by having the operator keep a button constantly depressed. The accelerator is inductively controlled. An insulated wire is fastened just under the rail head. When the retarder operator takes control of the accelerator, a blue light supported 16 ft. above rail level by a mast, is lighted and a bell rings as a warning to persons of its movement. Headlights on each end are also lighted. The front of the device has a large resilient plate for pushing against the car coupler. If the accelerator stalls while pushing a car or cut, the blue light flashes and driving power is cut-off from the driving motors. The operator must place the controls in the « off » position before further movement is possible. In emergency, the accelerator can be stopped, from the ground, by pulling an emergency cord on the side of the device. The accelerator can be moved beyond its control area by means of a manual control cable which is plugged into a receptacle on it



Power switchboard and rectifiers to charge battery for . . .

Cab signal system.

The cab signal system, as used on the hump locomotives, is of the inductive carrier type. The carrier is frequency modulated by the signal tones. Each locomotive equipment is made responsive to three tones, two of which provide for the four cab signal indications and the third provides for a frequency shift of the locomotive radio to a channel different from the general yard radio frequency. The locomotive cab signal equipment provides plug-in electronic units relays. The electronic units are transistorized.

Retarders and switch machine operation in the class yard.

The signaling equipment for this Young Yard, including the Class-Matic yard automation controls and the yard accelerator, were furnished by the General Railway Signal Co. All power switches are equipped with General Electric Cal-rod electric snow melters.

Communications facilities are everywhere.

This yard is well equipped with modern communications systems. They include : (1) talk-back and paging speaker systems; (2) mobile and walkie-talkie radio systems including Dick Tracy radio and paging speakers for skatemen; (3) television for

viewing car initials and numbers of inbound trains; (4) sound recording system for car checkers with various control points throughout the yards; (5) a local intrayard Teletype system and connections to the Central's IBM-Teletype car reporting system; and (6) a local PBX and conventional railroad telephone circuits.

The seven separate talk-back speaker systems give practically blanket coverage of the yard for the particular activity being carried on. Any loudspeaker can be identified as being associated with a particular system by colored bands on the pipe mast. Most speakers are mounted in back-to-back pairs on the pipe masts.

The 38 talk-back speaker pairs in the « orange » system are controlled from a console in the hump switchtender's office. He can also page over these speakers in the following groups: east of the hump; north and west of the hump; south and west of the hump and east end of the eastbound departure yard. The hump conductor's « black » system has speakers in the hump area to provide communication between the hump yardmaster, hump conductor, retarder operator, pinpuller and car inspector at the inspection pit on the hump lead. The hump conductor can page over these speakers as well as use them for talk-back purposes.

The « blue » system consists of 52 talk-back speaker pairs, which are along various ladder tracks and at switches at the west end of the classification yard. The control console is in the west-end yardmaster's tower office. These speakers are divided into three groups for paging: west of the yard office; east and south of the car repair facilities; and east and north of the car repair facilities. The « brown » system has 12 talk-back locations (divided into two paging groups), which are controlled by the east-end switchtender in the car inspector's building west of Oakland Avenue. This switchtender remotely controls the switches at the east end of the receiving yard.


Hump yardmaster's console has voice circuits for talk-backs, pagers and radio.

The diesel shop foreman has a control console for his « green » talk-back system which includes 13 outside talk-back pairs and 6 speakers located inside the shop. The car foreman has a similar system (« yellow ») which consists of 14 talk-back pairs outside and 6 inside the car shop. Both of these systems are divided for group paging.

A separate talk-back system was installed for signal maintenance in the retarder area (red systems). Inside speakers, often in the ceiling, are in the basement signal shop,

the relay and power rooms (retarder battery), the analog computer room, and the retarder operator's control machine. Outside, jacks are installed in 2-ft. pipe masts located between each of the group retarders. The maintainer takes a portable reel-type speaker with a 50 ft. cord and plugs the cord into the jack. Thus he can unreel the cord, taking the speaker to the particular retarder, switch machine or instrument case where he is working. When the maintainer talks, he is heard on all the speakers in the retarder building, as well as the hump switchtender's office.

Paging system in class yard.

A general paging system, using 30-watt speakers mounted on 40-ft. wood poles and floodlight towers, covers the classification yard. Direct access to this system is provided by consoles of the terminal trainmaster, hump conductor, hump yardmaster, hump switchtender, west end yardmaster and car repair foreman. Several telephones (Automatic Electric type 43 monophones) on talk-back speaker poles can be used to page over this system. They can also be used to answer calls over the paging system originating in the hump yardmaster's office. The skatemen's Dick Tracy radios can also page over this system (details later).

Several direct intercom circuits are between communications consoles of men such as the hump yardmaster and retarder operator. The general yardmaster has eight such direct connections, the hump yardmaster has nine, etc.

The equipment for these paging and talk-back speaker systems was furnished by the Electronic Communication Equipment Co. The cable for these systems was made by Ansonia Wire & Cable Co. The design is a shielded, all-purpose star quadded polyethylene cable worked out by the communications people of the railroad.

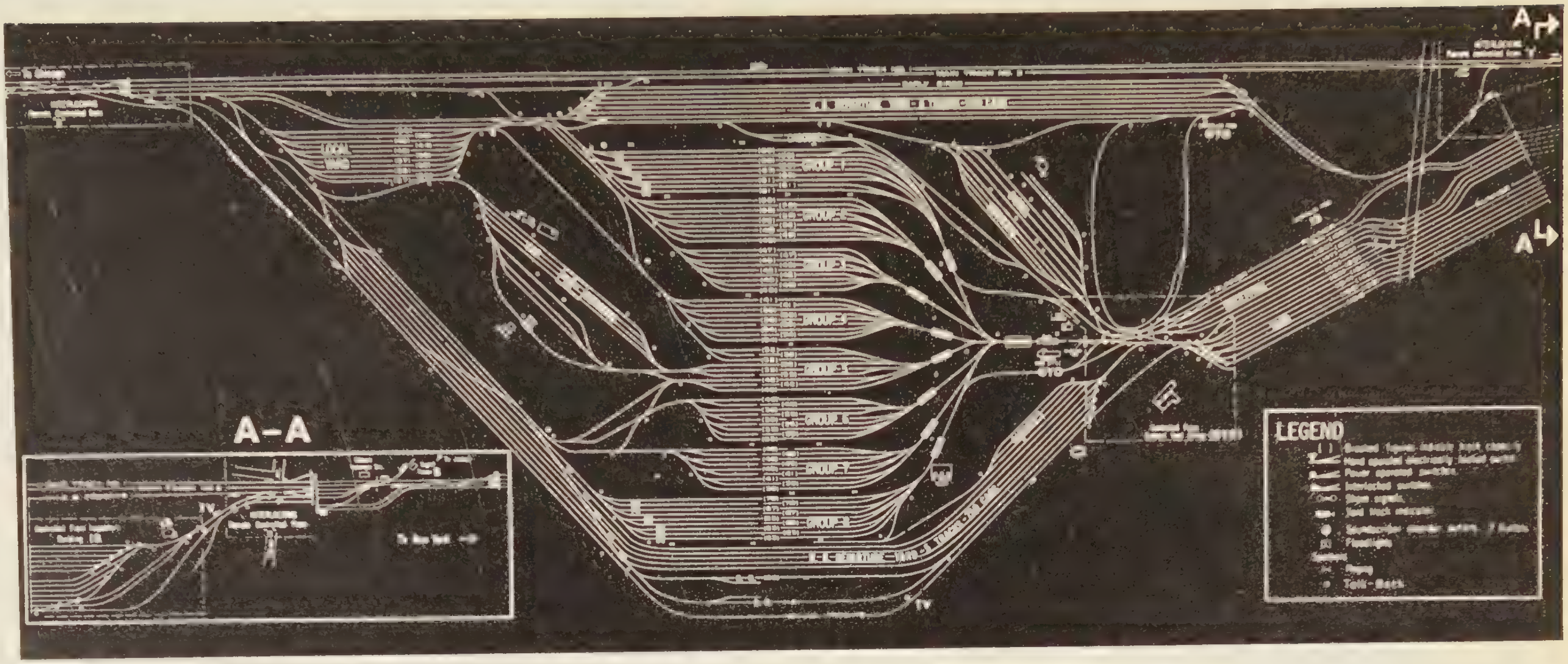
The three hump engines (each consisting of one 2 000-HP switch engine and one 1 000-HP hump trailer coupled) are equipped with dual-channel Motorola single-package radio with the transistor power supply for direct operation off the 64-V D.C. engine-starting battery. The hump frequency is 159.99 mc and the yard frequency that these engines may use is 161.73 mc. The base station equipment is in the hump yard office with the yagi antenna (hump frequency) mounted on an adjacent light tower. A lance-type antenna is used for the yard frequency. Antenna leads are RG-17/U coax cable. Remote controls of the base station are extended to the hump conductor, hump yardmaster, hump switchtender and retarder operator.

A feature of this radio is that the locomotive radio operation on hump frequency is dependent upon the conductor having selected to transmit cab signals to the locomotive. When he selects the yard locomotive for cab signal transmission, the receipt of this inductive signal on the locomotive actuates a relay to switch the locomotive radio over to hump frequency. Thus the hump conductor talks to only one hump engine at a time, which insures privacy of the hump radio system to the engine working the hump.

The five yard engines also have this transistorized radio operating on two channels: 161.73 mc and 159.75 mc. The latter frequency is for use with walkie-talkies carried by the switch crew foremen when working the west end pulling cars from the class tracks to build trains in the departure yards. The base station for this 159.75 mc frequency is at the west-end yardmaster's office, the lance antenna being atop a 110-ft. floodlight tower. The west-end yardmaster, hump conductor, retarder operator, hump switchtender, and hump yardmaster can get in on this yard radio system. The hump and yard engines have footboard speakers which receive all calls to the engines, and can be used to initiate engine radio calls. They do not have the intercom feature between the footboard and the locomotive cab.

The two engines working industrial areas around Elkhart and west of here on the mainline to Osceola and Mishawaka (11 miles) have dual-channel radio equipment operating on 160.17 mc for this industrial

Communications covers this yard with loudspeakers, radio voice recorders, phones, TV, printers and pneumatic tubes.



use, and the 161.73 mc Robert R. Young yard frequency. The terminal trainmaster has a remote control line off the base station at Osceola (5 miles), which is at the midpoint of the area worked by the engines.

Car inspectors have packsets.

The car inspectors carry dual-channel walkie-talkies : 159.57 mc for transmitting and 160.47 mc for receiving. The transmitting base station is 800 ft. from the receiving base station, so as not to desensitize the receiver. These inspectors work the trains in the receiving yard, as well as the outbound trains in the departure yards. The hump yardmaster and the car foreman can get in on this system.

Car inspectors carry dual-channel walkie-talkies to help them in their work.

Dick tracy aid skatemen.

Skatemen working at the west end of the class tracks carry portable Handie-Micro-Talkies which transmit on 161.13 mc. The base station receiver is at the west-end yardmaster's office, the yagi antenna mounted on a floodlight tower. This receiving base station feeds an incoming radio call into the classification yard paging system, as well as into communications consoles on the desks of the west end yardmaster, hump yardmaster and hump conductor.

A skateman can selectively call over his micro transmitter. Pressing the push-to-talk button once puts him on the paging system; three times selects the west-end yardmaster; four times selects the hump yardmaster; and five times selects the hump conductor. Two was purposely omitted, because a man might inadvertenly press the button twice.

The radio equipment, including the walkie-talkies and the base stations, was furnished by Motorola, Inc.

Television checks inbound trains arriving from east or west.

TV cameras are in metal housings at each yard entrance : view trains from the east near Oakland Avenue and view trains from the west from a point south of the local yard. The monitors and remote controls are in a car checking office on the ground floor of the hump yard office. When a train is due to arrive, the clerk will turn

on the camera, which is focused to view the side of the train as it enters the receiving yard lead. The trains slow to 10 mph when passing the TV camera. The clerk watching the monitor speaks the car initials and number into a SoundScriber recorder. This recording is later transcribed for preparation of the hump switch list.

The cameras, amplifiers and monitors are made by Radio Corporation of America. Night lighting has been installed for operation at night and on very cloudy days if necessary. The coax cable is run on messenger strand attached to wood poles. Two amplifiers are used for the 9 000-ft. run to the cameras at the east yard entrance, and no amplifier is used for the 1 000-ft. run to the west end yard entrance cameras.

Recorders for car checking.

An 8-station sound recording system has been installed, primarily for use in checking cars as they are pulled from the class tracks to build trains in the departure yards. The transmitting stations are in booths or telephone boxes, six of which are in the general vicinity of the west end yard office, the west end of the classification yard and the westbound departure yard. Two stations are also located near the east and west yard entrance TV camera sites for possible use in checking arriving trains. The handsets in these recording boxes are connected into SoundScriber recorders in the car checker's office room in the hump yard office (where the TV monitors are located).

The man at the box lifts the handset from the hookswitch, and listens to hear if the line is clear. If it is, he presses the push-to-talk button on the handset and calls the car numbers and initials. If he is interrupted or suspects that he has made an error, he can have the last few numbers played back to find his place, by pressing a play-back button on the instrument. Then he resumes recording. When he completes the checking, he hangs up the handset, closes and locks the phone box.

Recorders are paired for car checking so no cars are « missed » in a long train.

Meanwhile, the clerk in the office is alerted by a bell and indication lamp that someone is recording from one of these outside stations. He also knows that the inbound train is due to arrive. Simultaneous with the recording, the clerk may select to use a headset or speaker to take down the car initials and numbers directly. To avoid any possible errors, the recording is always made and later transcribed. Six recorders, working in pairs, are connected to the phone boxes, so that three 150-car trains can be checked without changing records. These recorders use vinylite discs, which hold 22 min. of recording. When the first recorder is within 30 sec. of the end of the disc, the second recorder is automatically cut in. Thus, no car information is lost as there is a 30-sec. overlap when both SoudScribers are recording.

Yard printer circuit.

Hump switch lists are sent via printer from the hump yard office to the hump conductor, hump yardmaster, west-end yardmaster and retarder operator, each such office having a receiving page printer. This printer circuit is also fed into the magnetic core memory unit for programmed automatic switching (explained earlier).

Pneumatic tubes connect the general yard office at the hump with the west-end yard office and the switchtender's location at the east end of the receiving yard. These are Grover Co. double-direction, single 6-in. tubes, which are used for transmission of waybills, orders and other papers.

The telegraph office at the 21st Street general yard office is to be moved into the new general yard office at the hump, which is, in effect, the communications headquarters of this new yard. The IBM-Teletype equipment used for car reporting is in this building, as is a communications maintainer's shop.

[656 .235 (42)]

The proposed new British railway freight tariffs,

by J. R. Pike, M. Inst T., London.

From a conference held on the 5th December 1956 at York, with the « Federation of Railway Lecture and Debating Societies ».

(« *Bulletin des Transports Internationaux par chemins de fer*, » September 1957 issue.)

According to the terms of the 1947, Transport Act, the British Transport Commission has to submit its proposed tariffs for approval to the Transport Tribunal. This requirement was completely modified by the 1953 Transport Act. Before this act was passed, the Transport Tribunal had already examined and put into force a proposed tariff for passenger traffic. The preparatory work in connection with a proposed freight tariff was already well in hand when in 1953 the new transport law introduced fundamental changes, so that the proposal had to be reviewed as a whole and could not be submitted for approval until the beginning of 1955.

It would appear that the new proposals are the most complete revolution that has ever occurred in the history of the British Railway tariffs. The two most important previous revisions took place, one towards the year 1900 when the 1888 Railway and Canal Traffic Act came into force, and the other in 1928 based on the 1921 Railways Act which governed the tariff system up to the 30th June 1957. Although the extent of these two revisions was considerable, neither the one nor the other modified the fundamental principles on which the railway freight tariffs had been based for more than a century. It is fitting therefore to analyse briefly in what follows the reasons for this tariff revolution, and in this analysis to ask ourselves the following three questions:

1) Why make a change?

2) How is the change to be made?

3) To what will this change lead?

1) *Why make a change?*

First of all it may be asked why the proposals did not retain the traditional system of standard charges. To deal with this question it is necessary, without going into details concerning the British tariff annals, to cast a retrospective glance and call to mind several important points.

All transport presupposes two elements, namely on the one hand the means through which the movement is carried out, viz., the installations, and on the other hand the means of transport, i.e. the means used as vehicle. This distinction is important. Like a navigable canal, the railway is a special type of road making it necessary to use a special method of transport. The road, on the other hand is not a specialised method of travelling, it does not require special methods of transport and can be used by anyone.

Originally, these two elements — the track and the method of transport — were considered as two distinct factors. The old highways were maintained by the highway departments for the use of the cars and other road users. The canals were built and maintained by contractors for the use of the boatmen. At the beginning it was thought that like the canals the railway was going to be a new form of specialised roadway to be used by transport undertakings, but very soon the method of traction by locomotive revealed the impossibility of this idea. In the railway field, we thus find for the first time the partial reunion of the two factors; for the railway is not merely the iron road, it also supplies the means of traction and to

a certain extent, the vehicles, i.e. the wagons and coaches. One expression of the old idea has remained in the case of privately owned wagons, the use of which was very widespread until quite recently; moreover formerly the accessory services in connection with railway transport were carried out by the haulier on behalf of the users.

All these facts have obviously exerted a considerable influence on the form and scope of the tariffs. The canal undertakings and highway authorities charged tolls for the use of their ways of communication. These tolls were graduated according to the capacity of the user to pay and the cost of transport which the value of the goods could stand : low value freight got off more lightly per ton than manufactured goods. From the economic point of view this is quite understandable in the case of undertakings whose costs mainly consist of constant items which are so to speak independent of the volume of traffic.

The railways followed this example. For the use of the railway maximum dues were fixed to which were added additional dues for the motive power and for supplying wagons. Later on these toll dues and charges for supplying rolling stock were combined, whilst the charges for loading, unloading, the use of the transhipment installations, etc. (terminal services and facilities) were only regulated when the 1888 Railway and Canal Traffic Act came into force. It was only then that the separation between the actual transport and the loading and unloading operations were codified for the first time. The conception of legal tariffs remained the same, i.e. the rates remained a function of the presumed level of rates the goods to be transported could support. With this object in view a classification of goods was prepared, which indicated their different classes and the maximum rates applying.

To sum up, the principle which had been instituted was that the price of railway transport should be determined according to the value of the transport to the user, rather than the cost of the transport to the transport undertaking. The level of tariffs had to be fixed in such a way that the rates as a whole would produce a sufficient income for the undertaking. The transport rates included the elements which were formerly separate : « tolls » and « charge for using the rolling stock », forming a whole, whereas in principle the tariff made a distinction between the price of transport on the one hand and the charges for loading and unloading on the other hand. This special discrimination whose historical origins have been briefly described seems to be peculiar to the British tariff system. Two other facts again complete the general structure of this tariff system, viz., the obligation to apply the tariff equally to all users in the same circumstances, excluding any favourable treatment, and the obligation to allow the users to consult the tariffs.

The Railways Act of 1921 made very few fundamental changes. The value of the goods continued to be the main factor in the establishment of the new classification which however replaced the former 8 classes of the old classification by 21. The new standard charges were shown by a scale of rates which still made a distinction between the actual transport and the loading and unloading operations. The creation of exceptional tariffs was provided for and such tariffs could be drawn up by the railway but required the approval of the Transport Tribunal when they included charges 40 % lower than the standard charges. These exceptional tariffs could not be done away with or increased except in the forms prescribed by the Transport Tribunal and under certain circumstances the users had the right to put forward their objections. A great part of the statutary regulations were maintained and completed from several points of view. The standard charges were for the first time « national standards » by means of which every given rate could be measured and compared with the others. One of the objectives aimed at by increasing the classification was to reduce the need for exceptional tariffs; however, exceptional tariffs already in existence could continue to apply on the basis of agree-

ments made with the users. In practice the majority of these tariffs, in so far as they were not suppressed by the standard tariff, were incorporated into the new tariff structure. In general, it can be stated that this new system was not any relief for the railway which on the contrary had to suffer from the effects of more rigorous regulation and business requirements.

Until the first world war, the railway only had to meet the limited competition of the canals and coastal navigation services, both of which were restricted by geographical conditions. After the war, a new omnipresent competitor arose : the lorry. The development of freight transport by road and the fight the railway had to put up to meet this new competition is a chapter of modern history. The road haulier makes use of a non-specialised route, viz., the highway. He is not responsible for its construction nor for its maintenance, nor has he to meet any technical or other regulations concerning the regulation of the traffic. In fact, he does pay some contribution in the form of concession rights, but this refers to the vehicle used and is very different from having to look after a specialised route with all the technical expenditure this involves (construction, maintenance, etc.), which have to be met whatever the fluctuations in the traffic. In view of these circumstances, road traffic developed in the form of relatively small organisations, opening up new horizons to private transport which in recent years has developed at an increasing rate.

In the field of the cost of transport, the rates established by the road hauliers showed a tendency to be based on factors which affect the cost of transport, such as the volume and weight of the consignments, the ease with which they can be loaded and made into balanced loads. Unhindered by tariff regulations and unburdened by the ordinary commercial charges which fall upon large undertakings, the road hauliers attacked the main currents of traffic wherever conditions were favourable for profitable working. Consequently, they soon became formidable competitors of the railway which up till then had completely dominated inland transport.

Under these conditions, it is obvious that the charges for road transport are extremely diverse and very flexible. The traffic conditions themselves were very different and this diversity was reflected in the price levels fixed for the different individual services. For similar reasons the services supplied by the railway were also very varied. But as was stated above, the tariff system of the railways was governed by the principle according to which such variations were to be compensated on the general plane and each branch of traffic had to contribute, to cover the operating costs, an adequate contribution proportional to its presumed capacity to pay. This system, which is also found in other organisations, has certainly its merits, but it presupposes conditions approaching a monopoly or at least a situation where all concerned are on an equal footing. It cannot be justified in the presence of competition which attacks the profitable business and leaves the unprofitable strictly alone.

This is indeed the dominant consideration of the whole problem. It is the objective of the management to establish the tariff charges according to the difference between the average receipts and the average costs, or between the gross revenue and the net operating revenue. The railway, tied by its legal and commercial obligations and hampered by the relative rigidity of the system had no easy task before it when it was a question of fighting against the activities of its new competitor, not forgetting the repercussions of all its actions upon the other tariffs. Measured in relation to the standard charges which were mainly determined according to the comparative values of the goods, the reduced rates which were often necessary seemed enormous. But from the point of view of the comparative costs a rate per ton 60 to 70 % lower than the standard charge might under favourable circumstances prove profitable, whereas on the contrary under unfavourable conditions

the standard charge which is the maximum would not be.

The above is intended to show that the traditional railway tariff system is incompatible with the new conditions created by modern transport. This leads us to affirm that the changes in question are not only essential, but that they are coming much too late.

2) *How is the change to be made?*

First of all, it is necessary to examine the laws applicable. The 1953 law already included certain beginnings in this connection. It freed the Transport Commission from the legal obligation of equal treatment and unjustified preferences. But the practical scope of this innovation must not be overestimated. As is well known, during recent years, these prescriptions have been rarely invoked; as in the end the decisive factor remains ineluctable commercial responsibility. However, the above mentioned obligation has influenced from the start the formation of the railway tariffs and its total suppression could not fail to have certain important repercussions.

In addition, the clauses of the Road and Rail Traffic Act of 1933 concerning tariff agreements were abolished, but permission was given for more extensive agreements with users for part or all of their goods.

The proposed tariffs prepared according to the law of 1947 had to undergo certain important modifications. All the proposed tariffs had to include maximum rates. Where the maximum rates were considered impracticable or undesirable, the tariff might impose an obligation on the Transport Commission to establish reasonable unit rates which could however be disputed before the « Transport Tribunal ». In addition the tariff had to guarantee that the establishment of the rates was placed entirely in the unconditional and unlimited discretionary power of the Commission and that obligatory publication only applied to the maximum rates. The coming into force of the new tariffs had the effect of annulling Part III of the 1921 Railways Act (with a few exceptions of little importance for our analysis).

In this way the old legislation, the result of a lengthy evolution, was swept away and replaced by a few brief paragraphs and the British Railways were faced with the new possibilities — but also the responsibilities — offered by a new start.

It is in fact not easy to make a new start in such a matter. Three things however appear to be definitely gained : firstly, under a competitive regime, the drawing up of the tariffs should take place in theory and in practice by laying greater stress on the factors which reflect the costs (comparative cost of the services).

Then it is important to remember that even apart from any competition, the conditions under which a railway works are always subject to considerable variations, so that the costs are likely to suffer from serious fluctuations. Finally, the transition from the old system to the new should not be an abrupt break but rather a joint.

The Transport Commission considers that all transactions — not each transaction taken on its own, but the transactions grouped together in such a way as to form from the commercial point of view a reasonable tariff system — should cover their direct costs and make a contribution towards the indirect costs compatible with business conditions. The following costs are to be considered as direct costs, the cost of supplying and maintaining the wagons, tarpaulins, ropes, motive power and traction (including the traction for the marshalling services), the transhipment installations, depots, etc., i.e., those costs which vary with the volume of traffic. By indirect costs are meant the cost attributable to the permanent way, signalling, administration, etc., which are independent of the volume of traffic.

This general principle is not completely new. In the past, it has already been held that such a principle should, in some form or other, apply to railway traffic. But there is no doubt that so far it has never been formulated in this way nor put into practice. It also reminds us vaguely of the distinction made at the beginning of this study between the « road » and the « method of transport ».

In the case of freight traffic, the unit of transport is the wagon. The cost of all normal transport is due to the supplying and maintaining of the wagons in service and by making available loading and unloading installations. These costs vary according to the character of the traffic, the distance covered, the nature of the route, the importance of the marshalling services, etc. The cost of the permanent way and the signalling installations are divided over all the different kinds of traffic, including the passenger traffic.

The costs can in fact be calculated as a function of the wagon circuits, but commercial practice and custom requires that the transport charges shall be based on the ton. Consequently the transport charge for no matter what consignment depends upon its weight and the quantity of goods which it is considered can be loaded into a wagon. This second factor, namely the aptitude of goods for being loaded into a wagon has been called « loadability ». It is important to note that the « loadability » of goods is not limited to information concerning their density which can be expressed as kg per m^3, but rather an indication of the quantity of such goods that can be put into the wagon. This distinction, which is not very important in the case of goods transported in bulk, may be essential when it is question of such things as cases, barrels or machines.

The first thing which strikes one in the new tariff is its brevity The main part only consists of twenty paragraphs and two relatively succinct scales. The whole only takes up six printed pages. Very little in truth to contain the elements of tariff legislation. Without taking our analysis as far as all the details of this tariff, we will examine the prescriptions concerning the rates and this under the following headings :

1) form;

2) structure;

3) level;

4) services (facilities).

The maximum rates are given in the first scale of the tariff. These will be briefly examined under the above four headings.

1) *Form.*

The maximum rates are graduated according the seven classes of weight on a downward scae starting from 10 t. The downward scale was established taking into consideration the above mentioned factors : « the weight » and the « loadability ». The weight of a consignment is a concrete fact. Its « loadability » is a question of experience and is complicated by the fact that there is a great variety of different types of wagons, their dimensions and their loading capacity. The tariff based on the « loadability » of goods by means of a formula in which the said « loadability » is defined as the weight of the goods forming a consignment which can safely be loaded and carried in a 10 t wagon with a load capacity of 450 cubic ft. In other words, this is a sort of standard rule by which it is possible to measure the « loadability » and from this, the maximum rate. And since it is a question of the maximum rates, they are based on the extreme cases rather than on the average.

This idea of form implies that the maximum rate will be the lower as the weight of the consignment is the greater and its « loadability » more pronounced, and vice versa. Thus a 10 t consignment (or over) with a « loadability » of 10 t (or over) comes on a lower rung of the ladder, whilst a consignment of 10 t which only has a « loadability » of 2 t will be charged under the 2 t rate and fall within the maximum charge which if not necessarily 5 times greater than the 10 t rate, will not be very far off it. In the same way a 2 t consignment of goods having a 10 t « loadability » also comes under the 2 t rate because it often needs a whole wagon to itself, atlhough it only occupies one fifth of the available space.

It must be remembered that we are speaking of the maximum rates and consequently that there is always a sufficient

margin for adaptation to different circumstances. Nevertheless the principle which lies at the basis of this system is of the greatest importance. Let us suppose for example that the standard charge for a class 14 consignment on a certain run amounts to 100. The standard charge will always remain the same, independently of the weight of the consignment or its « loadability ». Now if the goods in question have a loadability of 8 t the maximum rates for consignments of different weights according to the new tariff, as distinct from the standard charges, will be as follows :

Weight of consignment. Tons.	Maximum corresponding rate.
8	60
6	72
4	99
3	130
2	175
under 2	284

The most important innovation of the tariff policy lies in the difference between the « comparative value » and the « comparative costs ».

2) *Structure.*

The maximum rate is composed of two elements : on the one hand a charge per ton, for the ten first hours, and on the other hand, a rate per ton for the time over and above. The first of these rates is fixed, and intended to cover the functions and services which do not vary as a function of the distance. These functions and services include above all the supply and maintenance of the wagons, the haulage and shunting and obviously the station services. The second rate covers the cost of the service of the wagons in connection with the transport, the actual transport costs, the shunting at intermediate stations, etc.

In this way it is possible to separate on the economic plane the two factors which represent the constituent parts of the service given by the railway. The effect of this system is to produce a clear arithmetical graduation of the charges calculated on the tons-miles, but it is in no way an equivalent of the old scale of charges for the tons-miles transported. Moreover, it has nothing in common with the old system of charges to cover the station services and transhipment, as applied in the tariff of standard charges. In fact, the new tariff system does not include any basis justifying the traditional separation of the different charges; the last vestiges of the special charges for loading and unloading — a source of disputes for a very long time — having been wiped out.

3) *Level.*

One of the most thorny and most discussed questions in this whole tariff problem is to decide how and at what level the maximum rates should be fixed.

We have already stressed the diversity of operations which the railway and its competitors have to accomplish to meet the transport services run in the interest of the community. We have also affirmed that the railway could not support a tariff system which in principle provides equal charges for all the traffic. Otherwise, it would be forced to establish competitive rates for traffic « below the line » whilst the traffic « above the line », for which no remunerative rates could be established and for which there exists no compensation, would be left to its discretionary powers.

If the accuracy of this thesis is recognised it will be possible to fix the maximum rates — representing the highest rates which can be charged — in such a way that they will link up with the maximum limit of operating costs. The maximum rates are selected at levels which have been described as corresponding to circumstances which though unfavourable, are not extremely so.

4) *Facilities.*

By « facilities » is meant the services rendered and the use of the installations provided, covered by the maximum charges.

As has already been abundantly stated, these are the services and use of installations which normally occur in the transport of ordinary goods, but the old meticulous distinctions have been done away with through the suppression of the special charges for loading and unloading. It is well known that in fact the character and extent of several of these services, characterised until now by a specific and fixed element of the charge, vary considerably. The new tariff takes a wide and more rational view by laying down that payment for such services, normally, is included in the maximum charges. The proposed tariffs in addition provide that the same maximum charges also cover the charge for driving and delivering loaded wagons onto private sidings.

The new tariff includes, it goes without saying, several other specific features, which the space available does not allow us to analyse here. The most important principles have been reported above we think. They bear witness to a new evolution, according to which the idea of comparative costs is the fundamental basis of the tariff, whilst the net revenue becomes the objective of each transaction.

We would like to insist yet once again on the fact that the present study deals with the proposed tariff submitted to the Transport Tribunal in March 1955. The said tariff which in the meantime has been approved and published by the Transport Tribunal corresponds in form and structure to the proposals made by the Transport Commission.

As regards the level, the Tribunal has agreed that the maximum charges cover the cost of transport under conditions which though unfavourable are not extremely so. But as regards the cost of the transport itself, the Tribunal has adopted a somewhat optimistic point of view. It has in addition introduced a few other maximum charges for certain given kinds of goods loaded in bulk.

As regards the facilities, the Transport Tribunal has adopted the liberal idea of supplementary services, as suggested, but only in the case of traffic at the stations. In the case of private sidings, the Tribunal has fixed lower maximum charges for the transport properly speaking, whilst all the other services in connection with private sidings will continue to be governed by the other system of « reasonable charges ».

So far it is certainly possible to affirm that the main objects which the Transport Commission had in view have been reached. The lowering of the level of the maximum charges and the prescriptions concerning bulk traffic and private sidings are it is true restrictions we had not counted upon, but they cannot be considered in any way exaggerated.

On the other hand, it is perhaps a little surprising that, in conclusion, the suggested tariff considers it undesirable to fix maximum charges for the transport of goods carried in privately owned wagons or for consignments weighing more than 100 t. In this case, the Transport Commission has the right to fix « reasonable » rates, with the reservation that the Transport Tribunal can settle any question regarding the « reasonable » character of such charges.

Whither is the change leading?

Despite the modifications made to the proposal by the Transport Tribunal, the new tariff remains essentially a tariff of maximum charges which in fact will only apply in all probability to a relatively small part of the traffic as a whole. This in no way justifies the conclusion that this tariff is not very important or only has a secondary significance. If it has already been described as a façade, we should prefer to call it a « signpost ».

In our opinion, the establishment of the prices is the most important duty of the commercial department of the Railway Administration. The new tariff which has profited by the freedom laid down in

the law of 1953, leaves a great deal of responsibility to future tariff makers who, within the framework of the new principles, will have to reconstruct the tariff system of the future for the railways.

The system coming into force as from the 1st July 1957 tends to facilitate the introduction of the new principles. During the years a vast quantity of special tariffs have accumulated. Most of these special tariffs have been incorporated in the new tariff system. Others have been cancelled. The old tariffs which afterwards have been included in the new system will gradually be re-examined and adapted to the new principes; this will give both users and the railway time to adapt themselves to the new regime and avoid in this way any cause of trouble in commerce and industry.

The new tariff includes scales both for « part loads » and « full loads ». There are still other auxiliary means of getting out the rates, but finally the responsibility rests upon the official charged with making out the transport prices. The new system supposes that he will have a thorough knowledge of the elements for which he has to charge and of their comparative costs. He must tend towards the application of new better and more economical methods, when the cost of transport is at a level which prevents competitive prices being established. Finally, he will see the results of his work from the net revenue realised.

[614 .5 (73)]

An end to Diesel dermatitis.

EJ & E, Rock Island and IC take steps to control skin troubles from Diesel oils, chromates, coolants.

(*Modern Railroads*, July 1958)

The accompanying article is one of a series of case history reports on American industry being sponsored by the Association of American Soap & Glycerine Producers, Inc.

While the subject it treats — Diesel dermatitis — is considered controversial in some railroad circles, there is no controversy about the fact that proper methods of control do keep the problem to a minimum.

The methods of control that have been adopted by the three railroads described in the article have had two favorable results. They have boosted employee morale and at the same time have had the effect of protecting management from what in some cases have been costly personal injury suits.

During the 1940's the American railroads came roaring into an era of unprecedented speed and power as the modern Diesel engine sent the steam locomotive out to pasture. They also came roaring into what *could* have been a major health problem — dermatitis.

How they faced the challenge is the subject of a recent field investigation by the Association of American Soap & Glycerine Producers, Inc., as part of its continuing educational campaign in the prevention of industry's number one health hazard.

In October 1951 a conference, attended by interested representatives of most of the major railroads, was called in Chicago. Its subject was « Occupational Dermatitis Among Railroad Workers », and the speaker was Dr. Louis Schwartz, industrial dermatologist and former Medical Director of the U. S. Public Health Service.

Based on an over-all investigation of the industry, Dr. Schwartz gave a broad outline of the principal skin irritants faced by Diesel workers. These included various solvents, soldering acids, crankcase oils and greases, chlorinated hydrocarbons. He concluded : « The main causes of dermatitis among railroad workers are the lack of proper cleansing facilities, the inadequate and distant wash rooms and lack of *proper* industrial hand cleansers; the use of irritant petroleum solvents and chlorinated hydrocarbon solvents to remove soil from the skin ».

The prescription for prevention was simple :

— Reduce contact with irritants to a minimum by strategically placing wash basins, equipped with properly selected skin cleaners and paper towels, no more than 100 feet apart, right in the workshop itself;

— Provide and urge the use of protective clothing and barrier creams where feasible — water-repellent creams for protection against chromates and alkalies, oil-repellent creams for use with fuel oils and greases (use of such creams also assures extra wash-ups, again gives extra protection through cleanliness);

— Educate the worker to the possible sources of skin troubles on the job and teach him how to use the preventive measures provided.

The talk had particular meaning for one railroad — the Elgin, Joliet & Eastern — which only a few years earlier had been hard hit by three combined lawsuits seeking and « ad damnum » of $ 150 000. (This was one of the largest sums ever connected with an occupational personal injury claim.) At that time it was alleged that the railroad was aware of the inherent dangers in handling the new Diesel oils and solvents and had not taken steps to protect its employees.

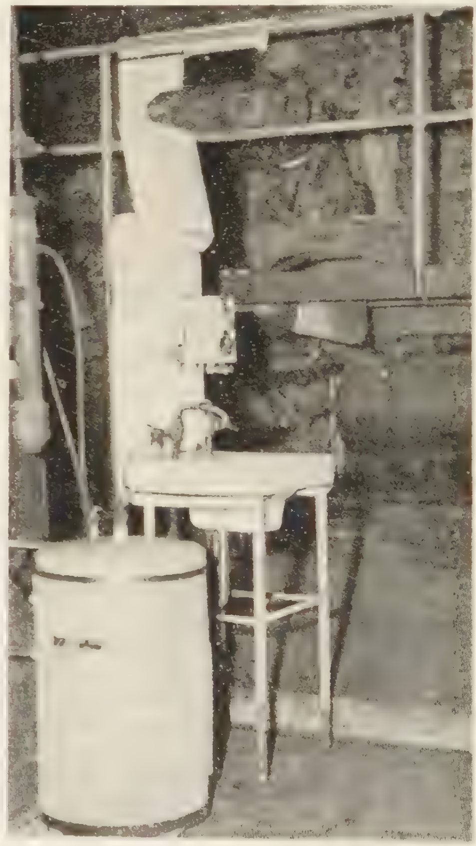
EJ & E's troubles had begun toward the end of '47 and first of '48, when various more or less minor cases of dermatitis began turning up in locomotive shops recently introduced to the new Diesel materials. Of these, three eventually developed into costly litigation.

The road began an immediate on-the-spot investigation of every case, checking where each victim worked, what materials he handled. It soon became clear that the majority of affected workers were in jobs directly concerned with the Diesel oils and chromate rust inhibitor solutions. It also appeared that these workers were not keeping themselves clean. Existing washing facilities — adequate in the steam engine era — were too few and too far away to cope effectively with skin irritants requiring immediate removal on contact. EJ & E started a cleanup campaign that included installation of more washing facilities and intensive employee education on the necessity for personal cleanliness.

Facilities conveniently located.

Today the EJ & E shops are models of good plant housekeeping, where cleanliness is the watchword and dermatitis has hardly a chance to get started. At East Joliet, where approximately 200 workers come in contact daily with potential skin irritants, special cleaning facilities have been installed to make skin cleaning as convenient and efficient as possible. These are in addition to the main washrooms in each building, which contain varying numbers of multi-outlet wash basins and modern showers.

In the locomotive shop, where the diesels are drained, refilled with coolants, cleaned and greased, and in the roundhouse, where running repairs are made, the special single and multiple washstands are spaced approximately 100 feet apart, *right next to the work areas,* and have a specially selected

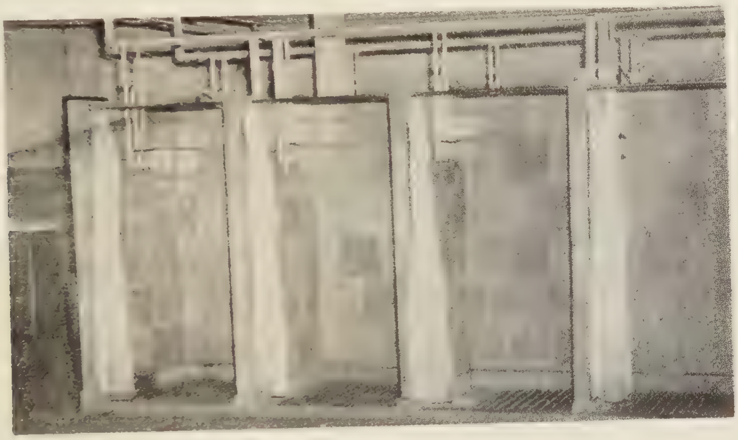


Convenience of facilities is major factor in dermatitis control. Here washstand is located right next to Diesel overhauling at E. J. & E. Joliet shop.

skin cleaner and paper towel dispenser.

No more than seven to 10 persons need use any one installation during a shift; there's no waiting in line for cleanliness at Joliet — a vital point in securing the cooperation of workers. Washing up frequently and thoroughly has become an unconscious part of the work routine.

EJ & E also provides many other protective devices — creams; waterproof aprons, gloves and sleeves; face masks, respirators; rubber boots and overshoes; and if required, hoods. All are in constant demand and used by virtually every worker coming in contact with potentially irritating substances, according to classification of the material and the hazard involved. Moreover, every worker issued protective garments must sign for them, indicating date of receipt. This provides a further check on who is and is not observing the safety precautions in the rare event that skin trouble does break out. (In one year recently at Joliet, the railroad spent over \$ 5 000 on skin cleaners, \$ 2 000 on protective creams, \$ 14 000 on clothing — and considers the investment worth every penny.)



Showers after work are part of over-all cleanliness campaign on E. J. & E. Shown is shower facility.

Employee education important.

Employee education in cleanliness is a continuing part of EJ & E's dermatitis prevention program. Immediately upon being hired, every worker who will handle potentially irritating materials is given an introductory sheet outlining the precautions to be taken with such materials, explaining the reasons for these precautions, and underlining the three cardinal rules :

— Avoid all unnecessary contact with oils, greases and solvents.

— Thorough and complete personal cleanliness is absolutely essential.

— All cases of skin irritations should be immediately reported. It is the constant responsibility of supervisors to see that employees follow to the letter the full content of these instruction sheets.

Other constant reminders of the need for cleanliness are the instruction cards above every washstand in the work areas. These detail how to wash up fully and effectively — how to apply the skin cleaner, work it into the crevices of the skin, add water slowly and wash off. The introductory « rule sheet » and wash-up instruc-

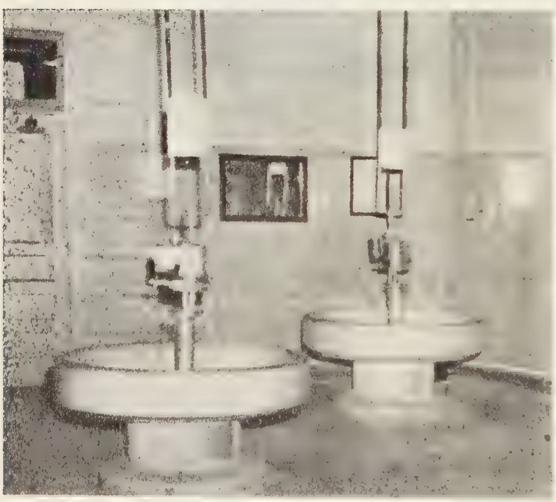
tions are also posted in every main washroom.

Proof of the effectiveness of the cleanliness program are the statistics themselves. Today dermatitis is a thing of the past in a shop where not long ago seven or eight cases a year had been the costly rule — rising at times to almost 15.

EJ & E's experience was not lost on other railroads — the Illinois Central and the Rock Island Lines, for example. Both railroads examined and overhauled their program of dermatitis prevention in 1953, after experiencing skin troubles from Diesel oils and coolants.

IC's preventive program.

Following a meeting of the Medical Section of the Association of American Railroads in April of that year, at which the Association also agreed that dermatitis preventive methods for Diesel workers should be instituted, representatives of the Central toured the EJ & E's Joliet shops. They noted the special installations there and modified them to fit conditions in their own Chicago yards.



Main washroom at Joliet has multi-outlet washbasins, special skin cleaner, washing instructions for employees. List of precautions is posted.

A station containing washstands and showers, then a considerable distance from the larger shop, was moved close to the main Diesel work area. In addition, an entire new building was fitted to one side of the roundhouse, equipped with additional washing facilities, showers and more lockers. A special emergency safety shower was also installed at the opposite side right next to a giant degreasing vat full of solvent.

Employee education was greatly stepped up, with strong emphasis on personal cleanliness in the periodic safety meetings. The talks stressed proper washing techniques and the need for using the protective creams and clothing provided. Such equipment includes waterproof gloves and aprons, and special face masks and tongs for use by workers on the solvent degreasing operations. Signs were put up on the central bulletin board as constant reminders of the need for watchfulness.

Rock Island improves facilities.

The Rock Island Lines took similar steps in 1953 to correct a rapidly worsening dermatitis situation. At its shops in Silvis, Ill., and El Reno, Okla., investigators found considerable skin trouble from leaking chromate solutions, and dry chromate powders which were being carried on air currents; also from hot solvent vapors escaping from degreasing tanks. Little was being done in the way of urging the use of protective clothing or creams or in educating workers on the need for cleanliness — though washing facilities appeared to be in good shape and the shops themselves were kept clean.

As a result of its 1953 investigations, this railroad, too, instituted regular cleanliness training programs in all areas where potential irritants were handled. Poster reminders were installed in washrooms and work areas. Comparative analyses of vari-

ous protective creams and industial skin cleaners resulted in the selection of one cream most effective in combating the solvents and chromates and one for the Diesel oils and greases, plus a non-irritating skin cleaner. These are now in universal use throughout Rock Island's installations. Washing facilities were even further improved and expanded.

Out of all the careful, painstaking investigation by the railroads of ways to combat dermatitis, the striking fact emerges time and again : *there is no substitute for personal and plant cleanliness.* This was dramatically emphasized when some of the railroads sought a way around the problem by substituting presumably non-irritating non-chromate coolants and rust inhibitors. The unhappy fact was that these simply did not do as good a job; within six months after their introduction, Rock Island Lines, for one, went back to the chromates. But after having learned how to handle the material, Diesel workers could still say goodbye to chromate dermatitis.

[625 .234 (44)]

The first realisation of heating railway stock by means of radiant panels,

by A. Antoni,

Ingénieur des Arts et Manufactures.

(*Le Génie Civil*, 15th June 1958.)

A very original application of heating by radiant panels has been made during the last two years by the French National Railways Company, in the equipment of vans specially fitted up for the « Société des Nouvelles Messageries de Presse Parisienne », for the rapid transport of newspapers from Paris to the large cities served by the lines of the south-eastern and south-western regions.

As soon as they come off the printing press, the papers are taken to the Lyons and Austerlitz stations and put in bulk in the vans, in which they have to be sorted and packaged during the run for delivery to the large provincial stations.

The vans therefore have to be heated like the coaches, but as in practice they are only used between midnight and seven in the morning, and with all the different methods of traction, it was essential to equip them with self-contained heating which could be quickly turned on and heat up quickly.

Heating by means of the classic methods (hot water or steam radiators) was impossible as there was no space available along the body sides which are completely covered on departure by the stacked up papers, so the technicians of the Rolling Stock and Traction Department of the South East Region of the S. N. C. F. considered the possibility of diffusing the heat by means of radiant panels arranged in the only free space available : the ceiling.

Carrying this out presented several difficulties. First of all, it was not certain that the space available would allow of the installation of a sufficient area of panels for an acceptable degree of radiation at low temperatures (40 to 45° C maximum) for the water circulating in the heating tubes, for the comfort of the staff. On the other hand, what hot water plant was there which would give a constant temperature and assure as far as possible a thermo-siphon circulation, already a difficult matter for an installation on the level and made even more precarious by the small differences in temperature between the starting and return circuits.

American authors experienced in heating by radiant panels which is widely used in the United States in the form of ceiling heating, advised that an average temperature of the heating fluid of 40° C should not be exceeded for ceiling heights of 2.20 m, corresponding to a calorific emission (a function as is known of T') of about 150 kcal/h m².

This limit was even more imperative in the heating of these vans since the water circulating tubes for raising the panels to a suitable temperature were hotter and closer to the heads of the occupants of the van than the panels themselves and completely uncovered.

Covering the whole available ceiling area of the wagons, only 18 m² of panels could be installed which in theory limited the calorific emission of the system to : 18 × 150 = 2 700 kcal/h. In the case of an ordinary wagon, even with good heat insulation, this would have been quite

insufficient and quite out of proportion to requirements. Luckily the piles of newspapers which made it impossible to install the classic type of radiators heating by convection, themselves formed very efficient insulating screens over the whole of the side walls which were already well insulated (double walls, air space and insulating glass wool); on the other hand, the loss of heat through the ceiling was automatically reduced by the insulating covering on the back of the radiant panels, to prevent heat being directed upwards.

These favourable arrangements reduced the loss of heat to be made up by more than half. As, moreover, it was possible to heat the van for some hours before it was occupied, whilst it was being heated up, hotter water could be circulated through the pipes, up to 65-70° C for example, thus raising the panels to about 60-65° C without any risk of discomforting anyone.

This programme, adopted right at the start, proved completely satisfactory, the water thermostats controlling the temperature of the panel heating circuits making it possible to run at two heat ranges: high temperature before the staff arrived and moderate while the van was occupied.

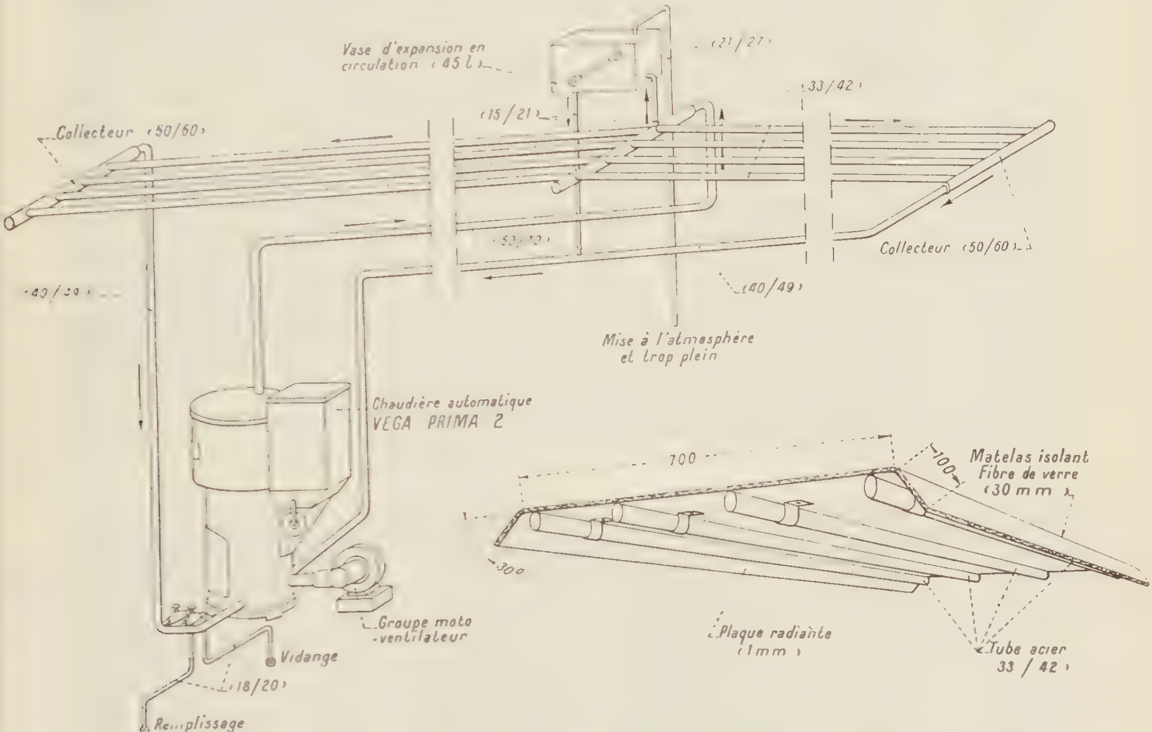


Fig. 1 and 2. — Diagrams of the whole of the radiant panel installation.

Explanation of French wording.

Vase... = 45 l expansion tank in circulation. — Collecteur = collector. — Mise... plein = outlet to atmosphère and overflow. — Chaudière... 2 = VEGA PRIMA 2 automatic boiler. — Remplissage = filling. — Vidange = draining. — Groupe moto-ventilateur = motor blower group. — Matelas... 30 mm = insulating mattress of fibre glass. — Plaque radiante = radiant panel. — Tube acier = steel tube.

The generator, as we have seen, had to meet very strict conditions of functioning and great flexibility of running, in order to be able to meet very rapidly any variations in the programme, which necessitated using an automatic boiler. As certain safety considerations made it unadvisable to use oil-firing, it was decided to use an automatic coal fired boiler.

The Rolling Stock Department of the S. N.C. F. which knew the good results obtained on the mail wagons and restaurant cars with the small Vega automatic boiler, and had appreciated the flexibility of its working on their « Bibliofer » coach, selected this type of plant for the heating circuit of the panels.

On the advice of the builders, based on experience with mail wagons working on the thermo-siphon principle, no pump was provided in the heating circuit, which avoided complications in the apparatus and in the electrical equipment and a considerable increase in the cost of the installation.

From the very first tests, it was clear that the priming of the circuits took place spontaneously and very quickly, which confirmed the wisdom of the choice of the thermo-siphon solution adopted.

The essential features of the Vega hot water boiler fitted in these vans for transporting newspapers consist in the complete combustion in a thin layer, obtained by a patented arrangement of tuyere blowing in the primary air, with the additional action of preheated secondary air and in the control of the rate of combustion by a thermosensitive element which operates the motor-blower and the amount of air and gives full or part working, instead of full or zero in the case of oil fuel (idling regime : 3 to 5 % of normal regime).

In addition, the very active climb in temperature due to the rapid heating of the water under the effect of the forced combustion and favoured by the smooth sheet cylindrical walls of the water-jacket greatly facilitate the working on the thermo-siphon system of the hot water heating installations.

The radiant panels consist of a simple sheet of steel 1 mm thick suitably shaped (fig. 2 and 3) capping four steel tubes 33/42 to which it is fixed by clips. The outside edges of the radiant panels are inclined about 30° in order to direct the radiation towards the centre of the van occupied by the staff and the back is covered by an insulating mattress of fibre glass 30 mm thick, to prevent any heat being emitted upwards.

The four tubes are welded in the middle to a central collector of 60/70 tube connected to the boiler outlet, and at each end, to a return collector of 50/60 tube connected to the return to the generator.

Figure 1 gives a diagrammatic view of the installation as a whole, with the radiant panel removed : on the left, the boiler with its motor-blower and its feed hopper for small coal; above this, the 60/70 piping feeding the central collector of the two half-groups of four 50/60 pipes, to the two ends of these groups the outlet collectors, from which the return 40/49 piping starts towards the boiler; in the centre, above, the expansion tank and piping.

The two control thermostats are placed side by side on the 60/70 piping immediately besides the boiler wall. The starting up thermostat is generally set at 70° C. By raising the panel to a temperature of between 60 and 65° C, it makes it possible to heat up the van very quickly before it is occupied, and in addition acts as a safety device for the boiler during this period. The normal working thermostat is generally set at 50° C; it assures that the panel is maintained at a suitable temperature to give comfortable heating. Changeover from one regime to the other is by means of a suitable hand switch, whilst the two thermostats are enclosed in locked boxes to prevent them being tampered with.

The departure circuit naturally includes a branch line in 15/21 tube to the 45 l

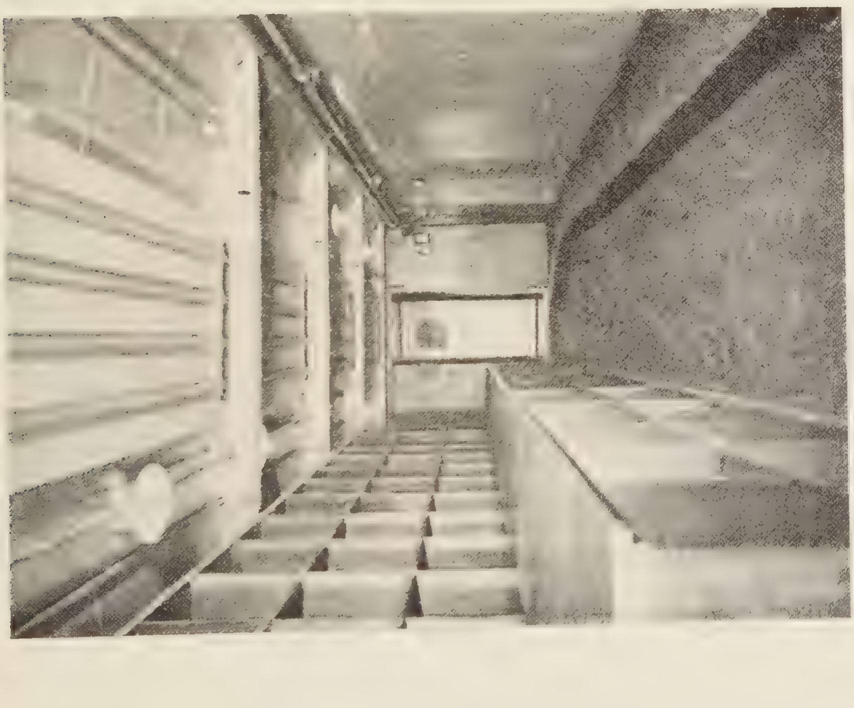


Fig. 3. — Interior view of newspaper van showing the arrangement of the radiant panel in the ceiling, with its four hot water pipes.

On the left, the pigeon holes and sorting table; on the right in the top part of the wall, the two hot water pipes for the arrival and return circuits.

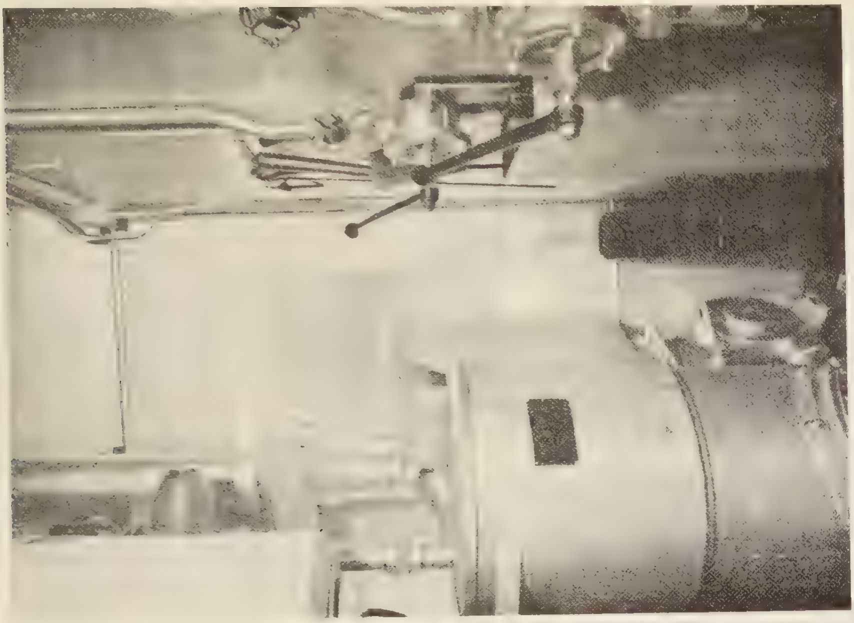


Fig. 4. — Vega Prima 2 boiler used in the « Bibliofer » coach of the S.N.C.F.

(Photos S.N.C.F.)

expansion tank in the cabin of the wagon, above the inlet collector. The overflow drains off under the frame through a 21/27 pipe.

The heating plant installed by one of the end vestibules of the van and opening into it is exceptionally compact since it only takes up 0.94 m² into which space is fitted the all-steel automatic boiler, its fuel hopper which can hold enough fuel for 24 h running on full regime, the motor-blower group which automatically supplies the combustion air, the smoke pipe and heating equipment.

Figure 4 shows an almost identical heating plant, equipped with the same Vega boiler, used for heating the « Bibliofer » coach of the south-eastern region of the S. N. C. F.

Figure 3 shows the interior arrangement of one of the vans, with its newspapers racks and in the ceiling, the four heating tubes and the steel plate with bent edges which forms the radiant panel. On the boiler room partition at the end, to the right of the door, are the control apparatus and automatic operating equipment of the motorblower of the boiler.

After two winters experience, it has been found that these heating installations by radiant panels have given as good results on rolling stock as they do in fixed installations (buildings and shops), both from the point of view of comfort and fuel economy.

The heating up of the space at the high regime takes place in 1 to 2 h, according to the outside temperature, and the staff enjoy the same comfort when the ambient temperature is 16° C, thanks to the radiation of the warm panels and walls, as when it is 18 or 19° C with convection heating with which the walls remain colder.

* * *

This application of heating by means of radiant panels in wagons is as far as we know the first such realisation in Western Europe. It assures under very advantageous conditions the comfort of the staff and shows that the technical services of the S. N. C. F. are making use of the most up to date techniques, even when equipping stock made only on very small numbers.

A new bridge with three chord members or booms now being constructed in Japan,

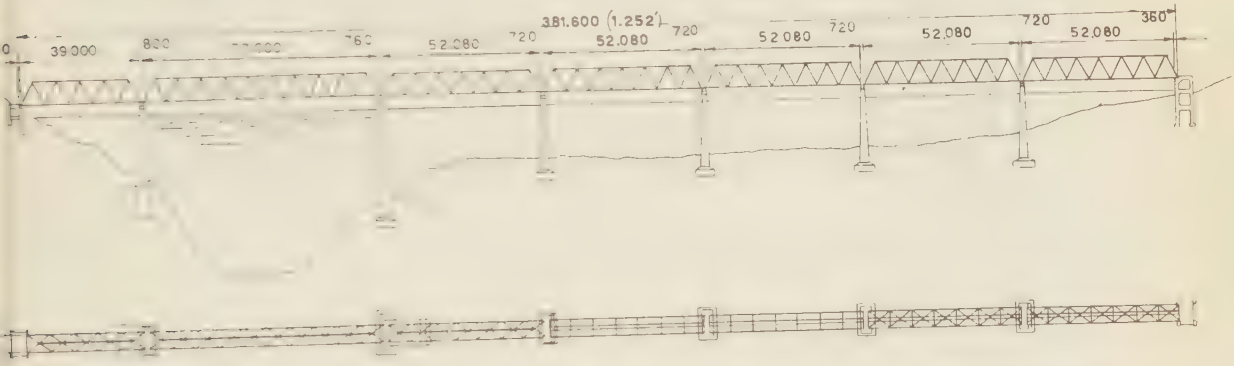
by M. Fukubei TAKABEYA,

Professor at the Yokosuka (Japan) Military Academy.

(*Acier-Stahl-Steel*, 2nd February, 1958.)

As part of the programme for the development of its natural resources and the reafforestation of the mining region of the Yubari district (Hokkaido), a new work was partly welded and partly rivetted, both in the works and on site.

The upper chord member of the 39 m span is a welded caisson beam with an



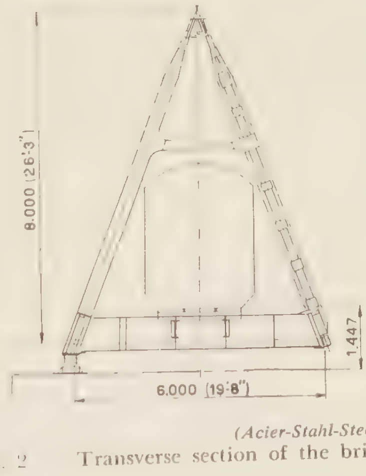
(Acier-Stahl-Steel.)

Fig. 1. — Elevation and plan of the bridge.

single track railway bridge is being built near the town of Jubari. The bridge is of the three chord or boom member type: the main beams are simple Warren trellis girders.

The bridge (fig. 1) has seven spans, five of 52.08 m, one of 77 m and one of 39 m. The total distance between abutments is equal to 381.60 m. The superstructure is 6 m wide between the centres of the lower chord members and it is 8 m high. The work has been entrusted to the Tokyo Steel Ribs and Bridge Works.

Figure 2 shows the transversal section of the bridge on the 39 m span. The total weight of steel used is 466.5 t. The frame-



(Acier-Stahl-Steel.)

Fig. 2 — Transverse section of the bridge.

upper flange of 430 × 9 mm, two inclined webs of 300 × 9 mm and two lower flanges of 110 × 9 mm. In the 77 m span the upper flange measures 400 × 22 mm, the inclined webs 400 × 22 mm and the lower flanges 140 × 22 mm. In the case of the 52.08 m spans, these dimensions are 430 × 13 mm twice 300 × 12 and twice 110 × 13. In the case of the 77 m span, the lower chord members have a flange of 200 × 25 mm and two webs of 300 × 22 mm. The sections of the chord members are shown in figure 3.

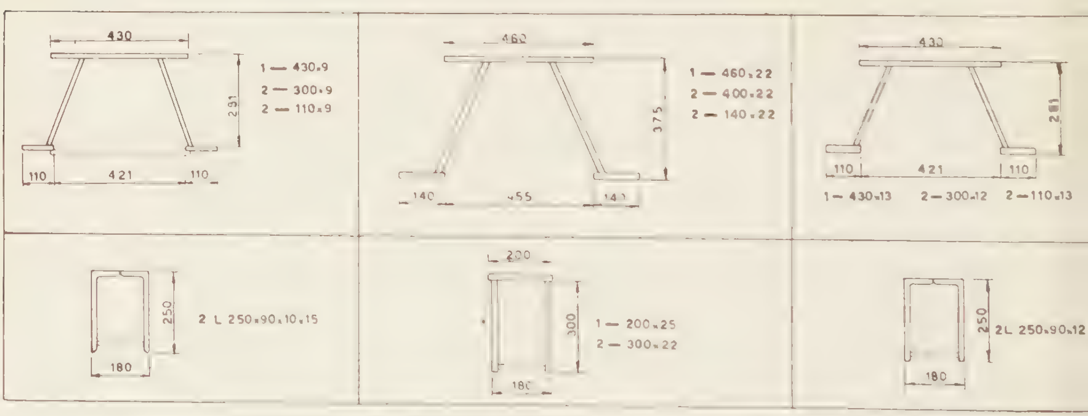
The weight of the framework components can be divided up as follows :

	Span of 77 m	Span of 52.08 m	Span of 39 m
No. of spans	1	5	1
End uprights	4.036 t	3.632 t	3.656 t
Upper chord member	19.582	7.407	4.421
Lower chord member	24.098	11.084	7.948
Diagonals	25.020	16.564	11.136
Wind bracing	6.272	3.858	2.859
Cross stays under track	8.454	6.152	4.518
Longitudinal members	13.108	8.936	6.688
Bearings	2.882	2.030	1.462
Bearing plates	1.600	1.350	1.350
Assembly bolts	0.328	0.223	0.168
Total per span	105.380 t	61.236 t	44.206 t

Travée de 39 m. Travée de 77 m. Travée de 52.08 m.

Membrure supérieure.

Membrure inférieure.



(Acier-Stahl-S

Fig. 3. — Section of the chord members at the centre of the spans.

N. B. — Membrure supérieure = upper chord member. — Travée de... = span of... — Membrure inférieure = lower chord member.

(Acier-Stahl-Steel.)

Fig. 4. — Assembly of the three chord member bridge in the works.

i.e. for the whole bridge : 105.380 t + 5 × 61.236 t + 44.206 t = 455.766 t.

The live loads taken into account include four 6 t axles followed by a uniform load of 1.5 t per m. The dynamic coefficient is 1.3. The wind pressure was taken as equal to 100 kg/m² in the case of the bridge with its live load and 300 kg/m² for the bridge with no load. Apart from these overloads, the official Japanese regulations concerning steel railway bridges have been adhered to. The design was mainly due to K. Kuroda Miyazaki, engineer and to the Chief engineer G. Ozaki.

---

(1) See also article by professor F. TAKABEYA : « Recent developments in bridge construction in Japan », which appeared in « Acier-Stahl-Steel » No. 10, 1955.

[625 .245 (494)]

A new special wagon on 18 pairs of wheels for the Swiss Federal Railways.

(*Bulletin d'Information C. I. C. E.*, No. 6, December 1957).

As more and more heavy machinery is built in Switzerland, the demand for special vehicles for carrying heavy and bulky loads is ever growing.

The Swiss Federal Railways (C.F.F.), in close collaboration with Brown Boveri & Co., completed the design of a wagon carried on 36 wheels and its construction was given to the « Société Industrielle Suisse » at Neuhausen and to Messrs Giovanola Bros. at Monthey. Within twelve months, the most modern and at the same time the highest capacity European wagon was put into service. As soon as completed, in February 1957, it was used to carry a stator weighing 206 t, part of the largest turbo-generator so far built in Europe. This 214 000 kVA Brown Boveri generator was loaded in the erecting shop at Münchenstein and delivered six days later to its consignees the « Rheinisch-Westfälische Elektrizitätswerke » of Essen, in the new works at Frimmersdorf, in the Ruhr.

This wagon has six bogies each of three pairs of wheels grouped together in two sets of nine pairs by four articulated bridge members (two large and two small) resting in spherical pivots. The large bridge members support the carrying arrangement which is solidly built. The carcase of the stator to be carried is fastened with the specially provided covers for the transport to the arms of the carrying arrangement, with which it forms a self-supporting girder.

The new vehicle has a tare weight of 98 t and can carry a load of 270 t. Its length of 33.4 m empty is as much as 43 m with the load.

The six wheeled bogies have a completely welded frame including the central spherical pivot and the side bearers. The frame rests on heavy plate springs and through them on the sets of wheels of 20 t loading and the roller bearings fitted. To obtain an equal weight distribution, the springs of two adjoining axles are connected through equalising levers. The third pair of wheels is independent. All the axles and in particular the middle pairs of the bogies have adequate side play (± 15 mm), which allows the wagon to run through curves of only 50 m radius in the works. The six bogies are alike in construction. They have complete brake equipment consisting of an Oerlikon distributor and a graduated load brake with four different positions. In addition, the two outer bogies have a bolster carrying the usual buffing and drawgear, a platform with hand brake, a railing and an intercommunicating gangway.

The *small bridge members* mentioned above connect together the two outer bogies by means of a spherical casting placed at the middle of the carrying device. The *large bridge members* connect the small ones to the inner bogies. At a third of their length, they support above the middle axle of the middle bogies a spherical centre casting of 150 t carrying capacity which acts as a bearing of the *carrying device* properly speaking. This latter part is built up from two massive girders in the form of arms made like the bridge members of steel plate and rolled sections. The whole is assembled by electric welding. Owing to the weight, « Feralsin » a special steel of 52 kg/cm² tensile has been

used to a large extent. At their centre the arms have on top two shoulders (thick plates) and below two strong eyelets to which are secured the covers for transporting the stator. To steady the load which is carried on two supports only one of the two arms has in addition to the spherical cap a roller side bearer.

The four bridge members and the two arms of the carrying device, weighing together 46 t, are of light construction. The material is under maximum stress when the wagon is fully loaded.

The cast steel spherical pivots weighing 426 kg work in an oil bath; they are located on the large bridge member and on double slides. Thanks to an electro-hydraulic lining up device they can be made to slide up to 35 mm off centre, on one side and the other in about 3 min. A hand pump is also provided in case anything gets out of order. The valves

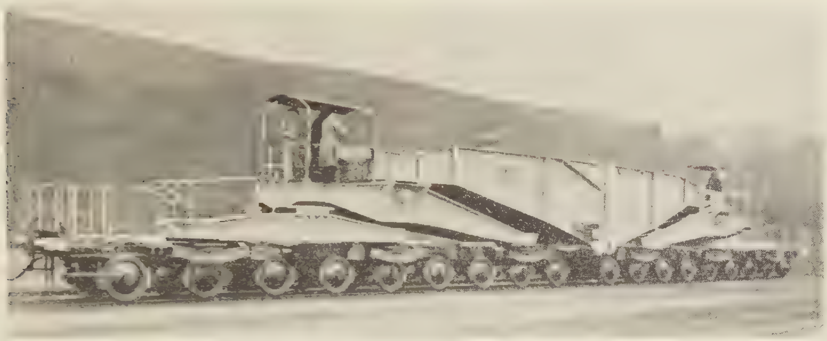


Fig. 1. — View of the 36 wheeled special wagon (empty) of the Swiss Federal Railways.

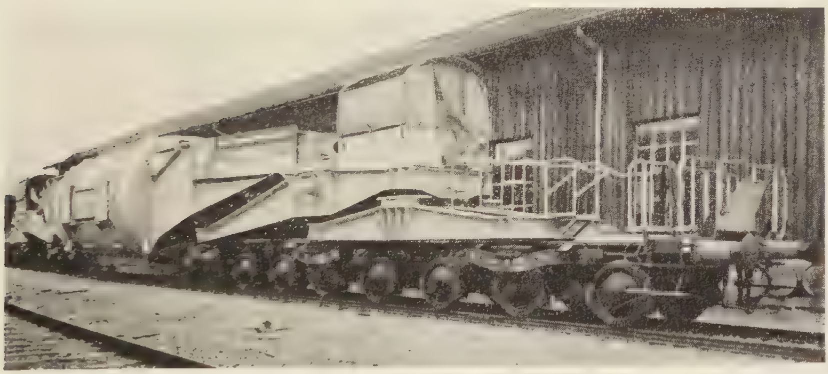


Fig. 2. — View of the same wagon carrying a stator of 206 t. It must be noted that the two-half wagons have been separated, the load being placed between them and supported on the special end devices; in this manner, the load forms an integral part of the wagon.

controlling this lining up device are placed on the operating bridge in a case in which the various parts are clearly arranged.

A bell system, also carried to the locomotive, makes communication possible between one observation post and the other; as soon as any obstacle arises possibly endangering an outside gauge load, the man in charge orders the driver by means of the bells to stop. The load is then displaced by means of the lining up device so that it can pass safely the critical point.

As transports of this kind usually take place at night when the traffic is less intense, on each platform six mobile projectors have been fitted to light up the parts of the load outside the vehicle gauge.

The electric current for the projectors and the lining up device is supplied by a generating set with a VW motor installed in an auxiliary wagon where also other equipment and the accompanying personnel are carried.

At the present time, few of such great loads have to be carried each year. In order therefore to get a rational use of the vehicle, three loading bridge members have been ordered by the C.F.F. with which three wagons each of six pairs of wheels with low loading platforms can be made up from the six bogies. In the case of heavy bulky loads which unlike the stators of which we have just written, cannot form a self-carrying load, the construction of a kind of carrying jacket is being designed.

As the authorised axle load of 20 t on most European railways has not been exceeded to any extent, the use of the vehicle is very little restricted. When crossing bridges, for example, several empty wagons have to be placed between the locomotive and the heavy load in order to avoid a too great load concentration. Finally, to prevent supplementary dynamic forces acting on such structures, the speed over them has to be reduced to a low figure.

Railway bridges in towns,

by Dipl.-Eng. Otto Bosch,

Higher Counsellor of the Bundesbahn. — Central Administration of the D.B. — Frankfort (Main).

(*Die Bundesbahn*, No. 16, August 1957.)

The constant development of our cities and extension of commerce and industry also increase the need for transport within the cities and their suburbs. Railways and city highways, railways and metropolitan lines, underground and above ground, large airports and landing grounds for helicopters, rivers, canals and harbours are all part of the communications system of the city of today and the future. The lines of communication cross one another and connect with each other and should be the subject of methodical planning to co-ordinate their mutual relations. The less the different methods of transport hinder each other mutually, the higher their output. This leads to the making of costly crossings at different levels; in large cities of international importance, at important centres it is often necessary to superimpose three or more lines of communication at different levels like the stories of a house [1]. Western Europe, however, has not yet reached the end of its evolution in the matter of transport: there may even be a further increase of traffic by rail, road and air. The ways of communication must be capable of assuring this additional traffic; in other words, they must be adapted and completed in view of future requirements.

In the interests of security and in order to increase the output, it is often necessary to modify the existing rail-road crossings and to make new ones. In this connection, it is advisable to replace level crossings by over or under bridges, widen the existing railway or road bridges, replace superstructures that have become insufficiently strong or no longer offer acceptable safety for the traffic.

Fundamental bases for studying railway bridges.

The technical solution of the problem set is determined by the situation of the railway in relation to the surrounding ground, as owing to the special features of railway operation, it is more difficult to modify the level of a line than that of a road. Most often in the large cities the railways are at such a height above the ground that the urban highways can pass underneath the lines. Near the large raised up stations, big bridges are necessary over the roads to link up the different quarters of the city separated by the railway. The drawbacks of such bridges — need for artificial lighting during the daytime, noise, ventilation, drainage — are eliminated when, as for example in Hamburg (central station) and Darmstadt, the lines in the town are at such a low level compared with the roads that the town traffic can cross over the railway installations by large road bridges. The separation of the different districts is then less noticeable and consequently might be said to be less of a nuisance. When the railway and its stations are at exactly the same level as the rest of the city, for example at Bonn, there is very considerable difficulty when it is a question of making new bridges over the roads. According to site conditions, over or under bridges are adopted, but often result in complicated layouts, with marked curves,

considerable gradients, long sustaining walls and drainage problems.

As the new city highways are now being made much wider than in the past, and the old roads have to be widened with as little modification as possible of their profiles, the height available inside a city to build a bridge — height of the inside wall of the bridge above rail level — is often very low compared with the span. Under such conditions, it is no longer possible to build as in the past arched bridges in natural stone, bricks or concrete, although an arched bridge often harmonises with the urban landscape (fig. 1).

Fig. 1. — Bridge with brick masonry arch over the Alteburger Strasse at Cologne-Bayenthal, built in 1912 13.

The new types of railway bridges [2].

The progress made in constructional technique has resulted in types of bridges which meet the essential requirements for town buildings: limited height, aesthetic appearance, reduced maintenance and long life. These conditions can be fulfilled with prestressed concrete bridges and a combination of steel and concrete, and with modern welded metal bridges in the static forms of slabs or slab-girders, gantries, trellis girders or hollow caissons, especially as with all these forms of construction it is now possible to lay the track directly on the metal or concrete deck with rubber plates, which reduces the height required. With the concrete deck slabs of metal, concrete or mixed bridges, the direct fastening of the rails has the advantage not only of reducing the height of the structure but also of considerably simplifying the section of the bridge, because there is no longer any need for a lateral layer of ballast.

In the last few years, a great number of different types of such rail fastenings have been designed and tested, with smooth or grooved rubber plates, with grooves on one side or both, or with cylindrical hollows of thicknesses varying from 5 to 20 mm. All these experimental designs have

Results of comparative measurements of noise on railway bridges, carried out in 1955 by the Bundesbahn Central Office, Minden (Westphalia).

Speed of test train consisting of : B.R.50 Loco. — Rake of wagons — V 80 Loco.		10 km/h			30 km/h			60 - 70 km/h		
		Noise in phones due to :								
Object	Position of measuring instrument	rake	steam loco.	Diesel loco.	rake	steam loco.	Diesel loco.	rake	steam loco.	Diesel loco.
Bridge with welded plate girder with track on rubber bearing plates	under the bridge .	82	84	85	90	95	98	95	97	98
	on the bridge . . .	82	85	89	94	96	98	97	100	102
	10 m from the bridge	82	83	86	94	96	98	95	99	102
Bridge with welded caisson beam with track on rubber bearing plates	under the bridge .	83	84	85	93	99	100	94	98	99
	on the bridge . . .	81	86	89	92	96	98	92	98	100
	10 m from the bridge	82	84	86	91	95	98	92	98	100
Bridge with rivetted plate girders with bed of ballast on pressed sheets continuous	under the bridge .	82	84	85	92	95	98	92	96	97
	on the bridge . . .	82	86	89	93	95	98	94	98	101
	10 m from the bridge	81	85	88	92	94	98	93	98	100

in principle given good results, and are invaluable for modern bridges of limited thickness, but for economic reasons, it will shortly be necessary to decide upon a standard type of construction, using to the greatest possible extent the standard components used for the construction of the permanent way, and dimensioning the elastic components in such a way that for a load per wheel of 6 t, the rail can fall about 1 mm in line with its fastening. The separate parts required for this standardised form of construction should be available from the permanent way stores, with the exception of the compensation wedges used to make up any differences in level in the track.

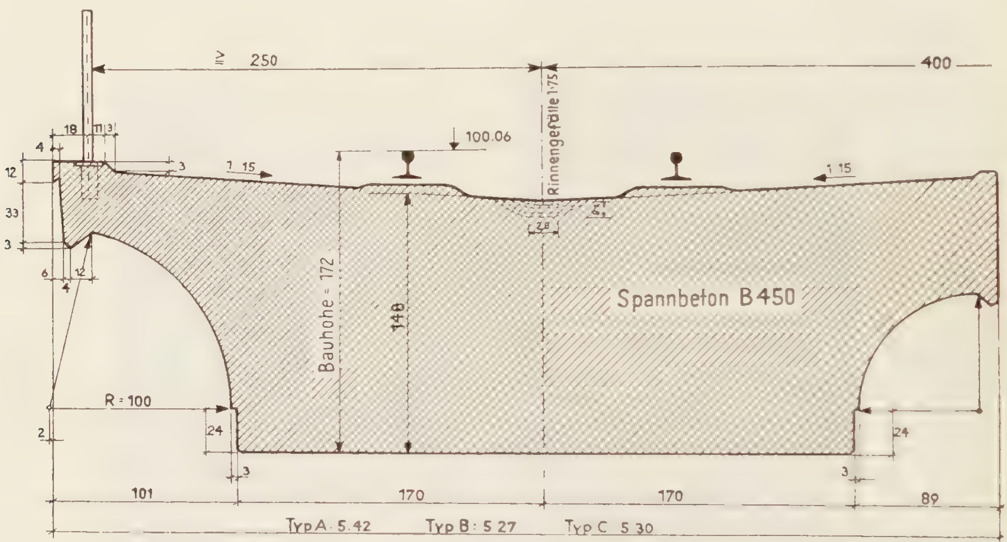


Fig. 2. — Cross section of bridge for the new Königsallee at Bochum.

N. B. — Bauhöhe = height of construction. — Spannbeton = prestressed concrete. — Rinnengefälle = slope of the flow.

Measurement of noise of metal railway bridges.

It is often claimed from subjective observations that with the direct fastening of rails on modern caisson or full web metal girder bridges that the running noise of the trains is less damped out and the dull rumbling near the bridges is louder than on metal bridges with an unbroken layer of ballast. To establish the facts objectively, the Cologne Bundesbahn Administration measured the noise caused by railway vehicles on three different bridges in living areas of the city, on one of which there was a ballasted track whilst on the two others the track was laid on rubber plates. To obtain comparable results, three bridges close to one another were selected, of approximately equal span — about 15 m — over which the same trial train was run, consisting of a series 50 steam locomotive, a mixed rake and a V 80 Diesel locomotive, at speeds of 10, 30 and 60 to 70 km/h. The result of the measurements, which are grouped together in the table, shows that the noise on the old bridge with a layer

of ballast and on the modern bridges where the track rests on rubber plates on a deck of thin sheets are more or less identical, so that both types can be used without inconvenience on railway bridges in cities.

The technical evolution, the broad outlines, which we have mentioned above, has led, as we shall show later on by means of several examples, to some very interesting examples of railway bridges in large cities.

Bochum : Bridge over the Königsallee.

In the reconstruction of the city of Bochum, the new central station was built 800 m to the east of the old station, which was severely damaged during the war. As a result several bridges had to be built, for the decks of which full precast concrete slabs were used exclusively, as this made it possible to make the whole of the bridge away from the railway. The new station was put into service on the 1st June 1957, so that now the bridge on the site of the old station over the future Königsallee the present width and siting of which no longer meet the requirements of the increased road traffic will now be renovated and widened. Six tracks cross the avenue on six single track precast concrete decks with a span of nearly 31 m, 1.72 m high (fig. 2). This height, only 1/18th of the span, is very low compared with concrete railway bridges and has been made possible because of the fact that the full slabs used for the decking are made of high quality concrete, entirely prestressed, and that the rails are fastened directly to the concrete slabs.

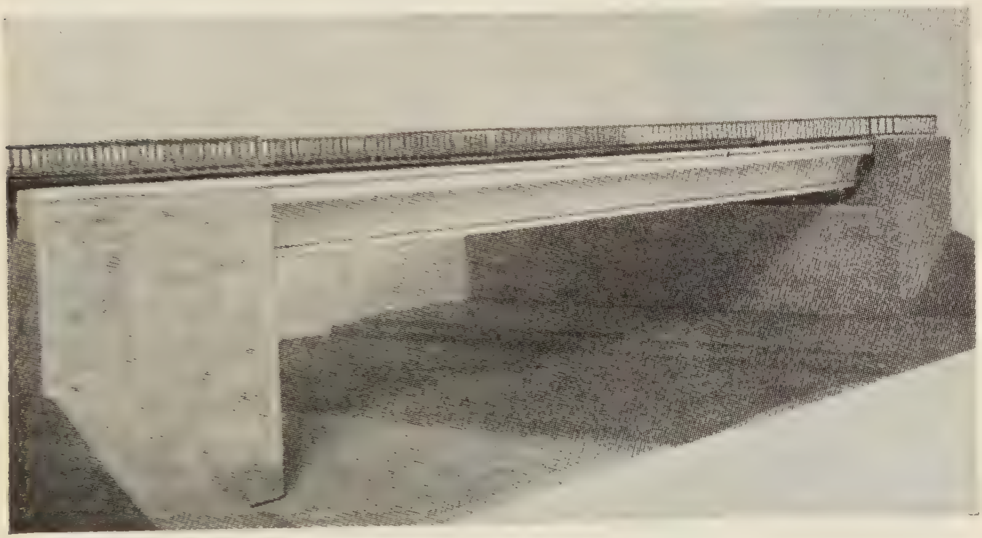


Fig. 3. — View of the new bridge over the Königsallee at Bochum (photograph of the model).

In the exterior arrangement of the bridge, the modern rounding off between the deck slabs and the cantilever will be noted in particular, as it differs considerably from the traditional forms, but gives a very light aspect to the 1.70 m thick slabs. The special features are shown in the model of the bridge which is on view at the International Building Exhibition at Berlin (fig. 3). One of the three

models of the deck is made of plexiglas in order to show the siting and arrangement of the 26 mm dia. prestressing steels, with a total prestressing of 4 200 t per deck (fig. 4).

shaped bridge section, the strong base plate of which is connected to the main lateral carrying elements by components which resist torsion. This method was made use of in 1953 when building the Zuckerdamm

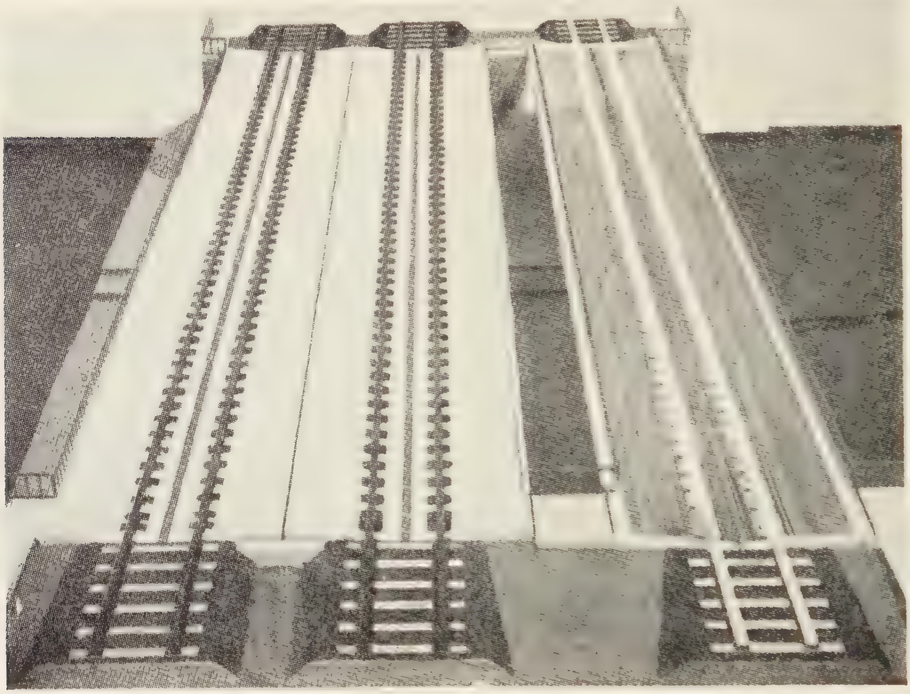


Fig. 4. — View of the new bridge over the Königsallee at Bochum (photograph of the model).

bridge at Neustadt (Holstein) and in 1957 for the bridge over the motor road from Cologne to Aix-la-Chapelle on the Duren-Jülich line (fig. 5).

Thanks to their adaptability and low height, prestressed concrete bridges are now so similar to metal bridges that nowadays prestressed concrete and steel are competing more and more against each other in the cities, even under difficult conditions.

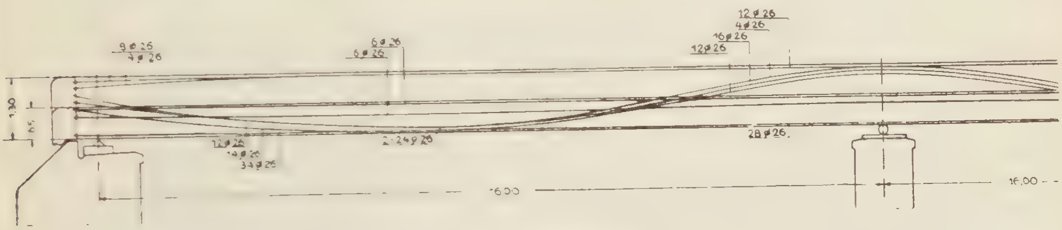
Neuss : Bridge over the new southern by-pass.

As at Bochum, in the south part of the city a new bridge is being built where a new by-pass crosses the present single track main line from Duren to Neuss, in the form of a continuous deck with two spans of approximately 18 and 22 m. On this bridge likewise, the rails are fastened directly to the concrete slabs with rubber plates between, so that the height of the bridge is only 1.28 m = 1/17th of the span. In the case of still lower bridges instead of slabs it is possible to use a U

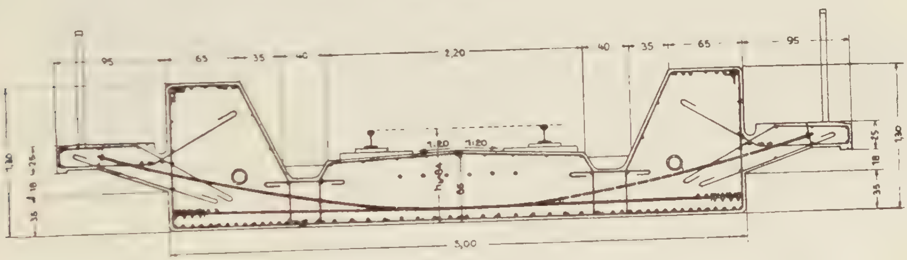
Frankfort-on-Main : Bridge over the Mörfeld road.

On the outskirts of the city of Frankfort-

on-Main, the Mörfeld road has been made as wide as the motor roads so that it can be used as an access road to the crossing of the Frankfort motor roads. For this to be done, it was also necessary to widen the three track bridges on the Frankfort-South-Frankfort Sportfeld and Frankfort-South-Frankfort Niederrad, to increase the opening from 14 m to 2 × 15 m with a crossing angle of 54°. The Mörfeld road which is very narrow at the crossing but carries a great deal the lines were closed. Four web plates and base and covering plates form a three compartment hollow caisson (fig. 6). To save weight, the base plates of the two end compartments are sheets of variable thickness welded according to the curve of the moments; as for the covering sheets of the two end compartments, these are strengthened to the required extent by means of plates welded on the inside. One deck weighs in round figures 68 t = 1.7 t/m. For the 2 m wide public



Coupe longitudinale.



Coupe transversale.

Fig. 5. — Longitudinal and transversal sections of the prestressed concrete slabs for the bridge over the Cologne - Aix-la-Chapelle motor road on the Duren-Jülich line.

of traffic only had to be closed to traffic at certain hours for the inevitable work on the road. Only one of the three tracks could be closed to traffic at once, and only for as short a time as possible. These reasons led to the adoption of three light metal hollow caisson spans with slightly lowered tracks, laid on rubber plates, in order to keep to the prescribed constructional height of 1 m which was put in place by two railway cranes in the short intervals during which footpath which also had to be included on this site, a hollow caisson metal deck 1.05 m high and 0.80 m wide was provided with cantilever brackets on each side. Owing to their smooth inside and side walls, and the simplicity of the longitudinal drainage above the abutments and pier, maintenance is simplified and cheaper, and the life certainly extended compared with the old metal bridges. Figure 7 shows the first of the new bridges shortly after erection.

Hamburg: Bridge at crossing of the Berliner Tor station.

A new single track bridge has to be erected at Hamburg, at the Berliner Tor urban station, when the urban line from Hamburg central station to Hamburg Bergedorf is electrified, on which the line lies on a curve of 386 m radius. For the main arches of 17 m and 2 × 39 m, a height of 0.90 m is available. For the small arches of 10.6 m span, as sufficient height is available, composite full girders are to be used for the decks with the upper track at a lower level. For the main spans, it is also desirable to use full girders to assure uniformity of design throughout the bridge. In view of the poor foundation soil, the decks for the wide spans have also to be designed as beams resting on two supports. In order not to interfere with visibility on the bridge, the sheet girders must not come any higher than the bottom of the windows of the urban trains which later on would use this bridge; consequently, it is necessary to use as light girders as possible, not more than 2.5 m high. It is therefore proposed to prestress the lower chord members of the composite beams to some extent by means of prestressed components on either side. The weight of steel will be about 3.6 to 4 t per m. In spite of the sharp curvature of the track, the main beams must be straight in shape; they will therefore be 6 m wide, so that the service footpaths can be arranged inside the main beams. We will return at an opportune moment to the technical details of the design and execution of the work.

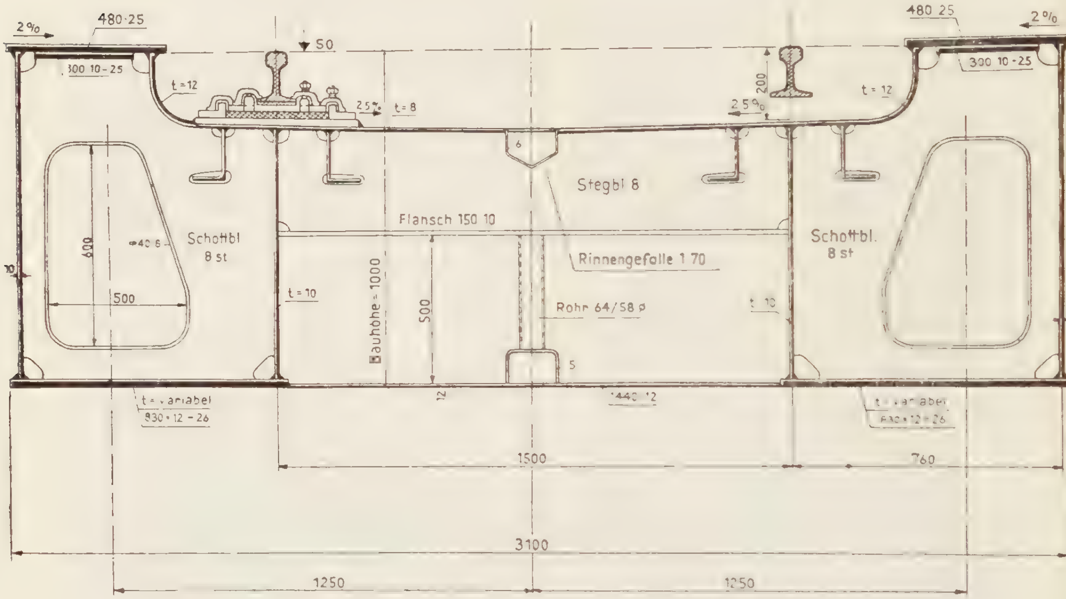


Fig. 6. — Transversal section of metal caisson bridges for the bridge over the Mörfeld to Frankfort (Main) road.

N. B. — Bauhöhe = height of construction. — Flansch = wing. — Stegbl. = web plate. — Rohr = tube. — Schottbl. = partitioning plate.

Essen : Main station and bridge over the Kettwiger Strasse [3].

The narrowness of the station site made it necessary when reconstructing the main station which was severely damaged to set back the façade of the passenger buildings and consequently reduce their area. In addition to the waiting rooms, stalls, etc., already under the lines, it was consequently necessary to add the consignment areas : ticket offices, cloak-rooms and express parcels offices. To this purpose, the platform must be excavated in the station area, at the same time, the former No. 3 end platform which is only connected to the east side subway passage is to be extended to the west side subway and the bridge over the Kettwiger Strasse on the west side of the station has to be increased by one track. These projects involve important temporary arrangements, with temporary bridges as low in height as possible, but closed in, as well as a great deal of bridge constructional work under very difficult and restricted conditions.

In the case of the temporary bridges, which must have a reduced height whilst assuring that the public offices under them remain completely covered, a new, rational design has been invented, which only weighs 1 t/m (without footpath and rail) for a span of 14.3 m whilst being strong enough to take an L train load. The inventor has applied for patents for this arrangement. A trapezoidal caisson section (fig. 8) carries on two triangular side caissons (fig. 8) the two rails which are fastened to the metal deck using 20 mm thick rubber section plates. The low constructional height of 60 cm is obtained by making the sheet covering the caisson section extend over practically the whole width between the rails. This form of section can naturally also be used with advantage for permanent bridges — with certain variations in the case of wide spans. Just as these temporary bridges have been designed and built according to the latest welding technique for metal structures, the numerous permanent bridges involved in the reconstruction of Essen Central Station will make full use of modern methods

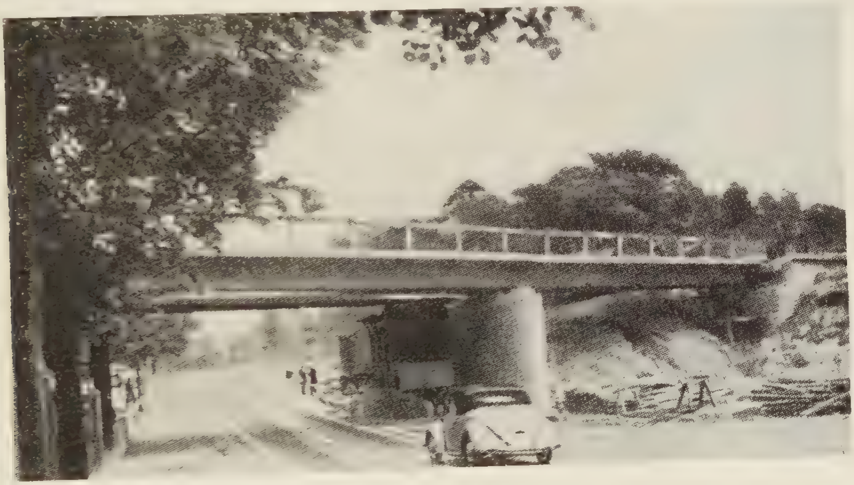


Fig. 7. — View of the new bridge over the Morfeld-Frankfort (Main) road after the first deck was placed in position.

of construction, according to their technical suitability and their economy.

The tracks and platforms over the cloak-room and express parcels office built in 1953 are supported by prestressed concrete bridges. In the case of those tracks which will be above the building now to be built which will contain the ticket offices and access to the platforms, it is proposed to use bridges made of five prefabricated concrete components, assembled by concrete run in on site and transversally prestressed steelwork to form the slabs. The decks made in this way will each have a span of 11.85 m and will rest upon articulated supports the cross pieces of which are covered by the slabs, so that in the new hall the ceiling will appear to be perfectly flat resting upon square metal posts. To damp out the noise, a light ceiling is suspended elastically under the bridges. With this method of construction, a considerable part of the work can be carried out in the contractors' works and work on site is reduced to the essential minimum. This is an extremely great advantage when reconstructing an important station where space is particularly restricted. It is as well to add that in view of the great number of prefabricated concrete parts (more than a hundred), the cost of manufacturing and erecting them can be very economical [4].

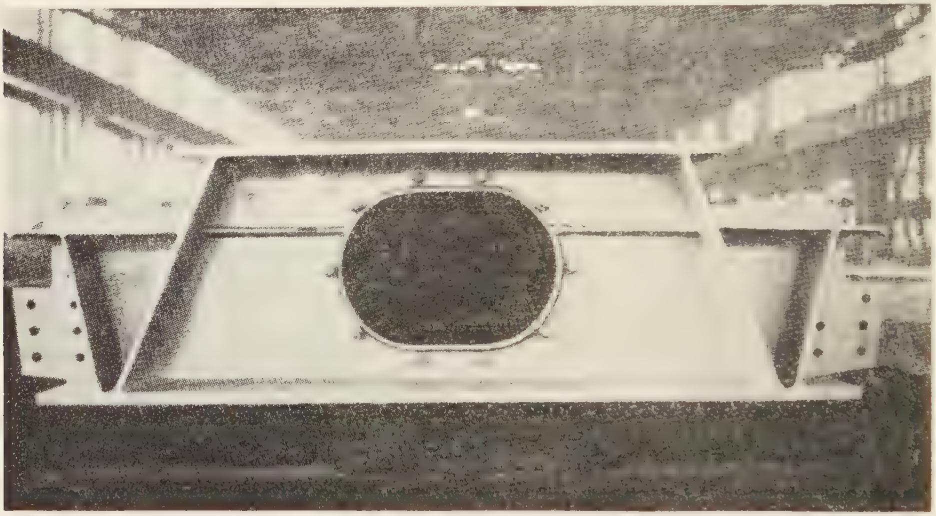


Fig. 8. — Transversal section of the new temporary bridges for the alteration of Essen Central Station.

To widen the bridge over the Kettwiger Strasse in order to take a new track and platform, a very attractive and economic solution has been found, a model of which was shown at the International Building Exhibition in Berlin (fig. 9). Including the shops alongside it, the Kettwiger Strasse is about 55 m wide, and is crossed by metal bridges with four spans of 10 m and three of 15 m. The new bridge is formed by a metal hollow trapezoidal caisson with great rigidity to torsion, in which three single intermediate supports are fastened which form supports having great rigidity to deflection, with strongly jutting

cantilevers on both sides (German patent sought). The three supports with a single pillar have a square section increasing from bottom to top : at the base 50 × 50 cm, at the top 105 × 105 cm. At the top they are as wide as the inner face of the hollow beam, so that they link up exactly with the deck (fig. 10). At the two ends, the hollow caisson beam rests on two supports; the stresses perpendicular to the longitudinal axis of the bridge are absorbed by the hollow caisson which has great rigidity to torsion, and transmitted to the abutments by means of the supports at the ends of the bridge. The height of construction of the deck, which will be given a layer of ballast, is normal and amounts to 1.5 m = 1/10th of the span. The weight of the whole, including the pillars, brackets, footpaths and rails, amounts to approximately 120 t, i.e. 2.2 t per m. The relatively low weight is explained by the fact of the statically favourable forms of the hollow caissons and the modern supports with only a single pillar, with which the 100 t horizontal shock of the road vehicles has not to be taken into account for two pillars as in the case of the usual support with two pillars, but only for one. In addition, nearly half the cast steel needed for the supports of the pillars is saved. To balance the horizontal stresses, the supports of the struts are connected, below the surface of the road, by truss rods which can be regulated if necessary with the supports, should any mining subsidences occur. Another advantage of this arrangement is the little room taken up by the supports, and the greatly improved visibility for the road traffic, compared with the massive piers or two pillar supports. Finally, nearly a quarter of the earthworks are saved, because the single pillar only needs *a single* foundation. It is to be hoped that this new form of bridge will

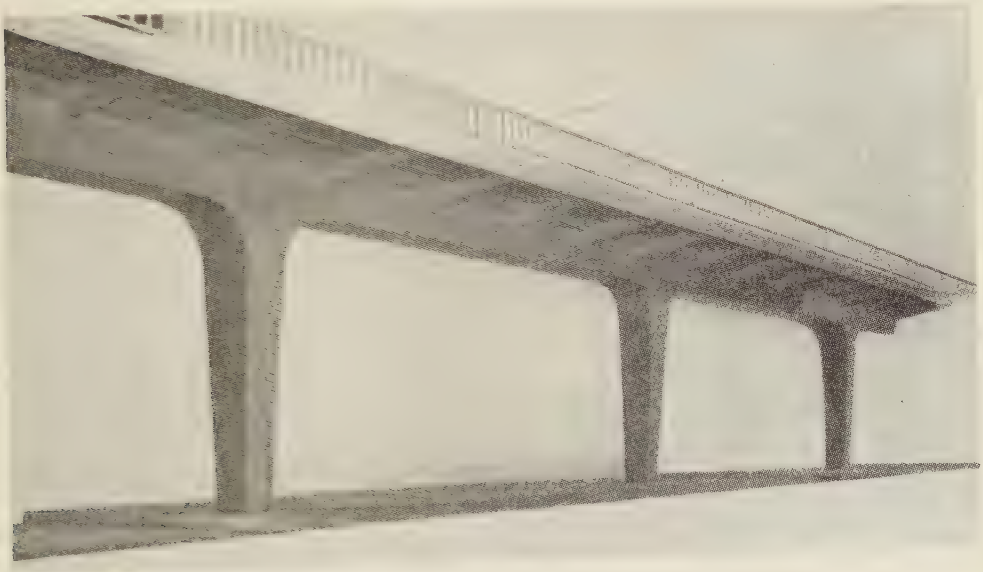


Fig. 9. — View of the new bridge for widening the bridge over the Kettwiger Strasse at Essen (photograph of model).

often be used in the future for road and railway bridges in towns, especially in the case of raised up roads, because the space under the bridge can be made much better use of.

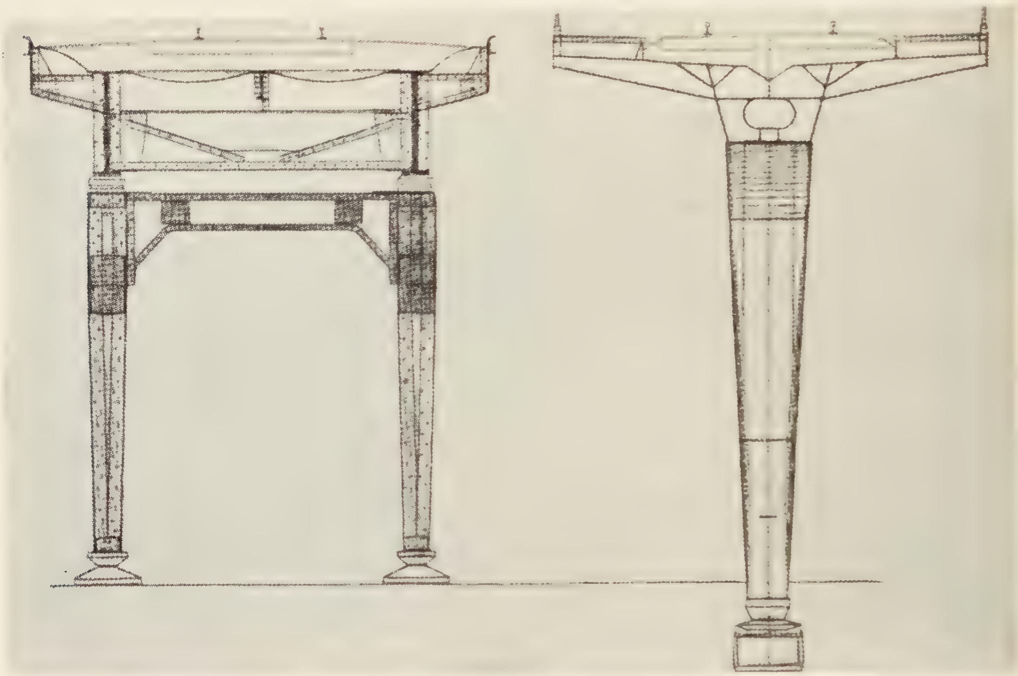


Fig. 10. — Bridge over the Kettwiger Strasse at Essen on the right, cross section of the new welded support, with caisson bridge; on the left, for comparison, rivetted support pillars with full beam welded (rivetted) deck.

Résumé.

Although the constructional height available is usually low, railway bridges inside towns must be made as economically as possible and be satisfactory from the aesthetic point of view. They must be able to fulfil their functions for many decades without having to be modified or strengthened. In this connection, preference should be given to a type of construction having the longest useful life and lowest maintenance costs. It is for the engineers to determine by means of comparative studies and devices which of the numerous methods of construction and combinations thereof are technically possible and economically realisable in each particular case.

Bibliography.

[1] LEIBBRAND, K. : « Verkehrsingenieurwesen städt. Verkehrsplanung für Schiene und Strasse » (Transport technique : proposals for urban traffic by rail and road), Birkhäuser Publications », Bale, 1957.

[2] ERNST, E. : « Neue Wege im Brückenbau » (New methods in bridge construction). « Die Bundesbahn », No. 19, 1954.

[3] HOFFMANN, E. : « Gewandelte Formen im Brückenbau durch die gestaltende Kraft der Schweisstechnik » (Modification of forms used in the construction of bridges under the influence of welding technique). « Eisenbahntechnische Rundschau », No. 6, 1957.

[4] EMMERICH/BITTERICH : « Montagebauweise - ein Mittel zur Rationalisierung im Brückenbau » (Prefabricated construction, a means of rationalisation in the construction of bridges). « Eisenbahntechnische Rundschau », No. 4, 1957.

NEW BOOKS AND PUBLICATIONS.

[**625** .14 & **625** .2]

Archiv für Eisenbahntechnik — Folge 10 (Dezember 1957). Beiheft der E.T.R. *(Eisenbahntechnische Rundschau)*. — A pamphlet (7 7/8 × 11 3/4 in.) of 52 pages with illustrations. — 1957, Carl Röhrig Verlag, Darmstadt, Holzhofallee 33*a*. (Price DM 12,—; for subscribers to E.T.R. DM 10,—.)

« Archiv für Eisenbahntechnik », a supplement of the well known review « Eisenbahntechnische Rundshau » devotes its tenth issue to three articles of great technical interest.

In the first « Das Kräftespiel an Diesellokomotiven mit Parallelkurbelantrieb und seine Rückwirkung auf Getriebe und Lager », Dr. Ing. Ch. W. Fabry gives a profound study of the distribution of the stresses in the motor mechanism and in the reverser-reducer of Diesel shunting locomotives with coupled axles. He has drawn some practical conclusions which should aid the builders in the layout and design of the organs studied.

Dr. Ing. A. D. de Pater studies in the second article « Das dynamisch Verhalten von Eisenbahnfahrzeugen in Gleisbogen », the dynamic behaviour of railway vehicles on curves. Using the analytical method of Logrouge, which he clearly explains in the foreword, he establishes equations for the movement of the vehicle. He applies his theory to the case of a locomotive with three coupled axles. He also calls attention to the value, in solving such complex problems, of electronic counters, which in particular make it possible to take into account the non-linearity of certain factors.

Finally, Professor Dr. Ing. Labil. Petthoff in « Die Eutropie einer Gleisentwicklung » reports a permanent way of studying the output of a set of marshalling sidings, taking into account on the one hand, the dispersion of the routes taken at the foot of the hump by the successive cuts, and on the other hand, of the running through the points by these cuts.

R. S.

CORRIGENDUM.

Bulletin for July 1958.
(**Madrid Congress, 1958.**)

Report on Question 4, by M. VIANI.

Table 12. — Dimensions and tolerances for brushes and brush holders.

Page 1053/41 : Belgian National Railways.

Instead of : Brush holders : width $\left\{\begin{array}{l} +0.5 \\ -0.25 \end{array}\right.$ thickness $\left\{\begin{array}{l} +0.20 \\ -0.10. \end{array}\right.$

Please read : Brush holders : width $\left\{\begin{array}{l} +0.5 \\ +0.25 \end{array}\right.$ thickness $\left\{\begin{array}{l} +0.20 \\ +0.10. \end{array}\right.$

Bulletin for September 1958.
(Madrid Congress, 1958.)

Special Report on Question 4, by K. J. COOK.

Chap. VIII. — *Cost of maintenance of electric locomotives.*

On page 1381/49, second column, there is :

$$y = 1\,000\,(a + 0.0893x + 0.11621x^2)$$
$$\text{and } y = 1\,000\,(1.14a + 1.321x - 0.01319x^2).$$

These equations should read :

$$y = a + 89.3x + 116.21x^2$$
$$\text{and } y = 1.14a + 1.321x - 13.19x^2$$

respectively, according to a late communication received from the Pennsylvania Railroad Company.

MONTHLY BIBLIOGRAPHY OF RAILWAYS (1)

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(DECEMBER 1958)

[016. 385 (02]

I. — BOOKS.

In French.

1958 691

ARRAMBIDE (J.) & DURIEZ (M.).

Agrégats, liants et bétons hydrauliques, aciers et métaux usuels.

Paris, Editions du « Moniteur des Travaux Publics ». Un volume (16 × 24 cm) de 600 pages. (Prix : 2 300 fr.fr.)

1958 621 .83

DUDLEY (D.W.).

La pratique de l'engrenage. Traduit de l'américain par L. BERGÈRE.

Paris, Librairie Polytechnique Béranger, éditeur. Un volume (16 × 25 cm) de 400 pages avec 165 figures et 124 tableaux. (Prix : 5 800 fr.fr.)

1958 691

FORESTIER (V.).

Calcul et exécution des ouvrages en béton armé. Tome II : *Précontrainte du béton. Fondation et superstructure des bâtiments. Silos. Canalisations. Réservoirs.* 5e édition, revue et complétée par P. BLONDIN.

Paris, Dunod, éditeur. Un volume (16 × 25 cm) de 258 pages avec 153 figures. (Prix : broché, 1 450 fr.fr.)

In German.

1958 621 .392

Handbuch Lichtbogenschweissen.

Berlin, VEB Verlag Technik. DIN A 5, 364 Seiten mit 325 Bildern. (Preis : Ganzlederin, DM 18.50.)

1958 624

Dr.-Ing. A. HAWRANEK & Dr.-Ing. O. STEINHARDT.

Theorie und Berechnung der Stahlbrücken.

Berlin, Göttingen, Heidelberg, Springer-Verlag. 426 Seiten Gr.-8°, mit 269 Abbildungen. (Preis : Ganzleinen, DM 66.—.)

1958 621 .31

Prof. Dr.-Ing. Max RECK.

Elektro-Starkstromanlagen. Band 1 : *Erzeugung, Umformung, Isolierung, Übertragung.*

Darmstadt, Georg Westermann Verlag, DIN C 5, 320 Seiten mit 245 Abbildungen und 16 Tafeln. (Preis : Ganzleinen, DM 22.80.)

1958 62 (01

SIEBEL (E.) & LUDWIG (N.).

Handbuch der Werkstoffprüfung. I. Band. 2. verbesserte Auflage.

Berlin, Springer-Verlag. 890 Seiten mit 1 015 Abbildungen. (Preis : Ganzleinen, DM 148.50.)

In English.

1958 537

Electric Technology, U.S.S.R. Vol. I, May 1958. Selected papers from *Elektrichestvo*, Nos. 1-4, 1957.

London, Pergamon Press Ltd., 4 and 5, Fitzroy Square, W.1. (Price : 120 s.)

1958 691

EVANS (R.H.) and **BENNETT (E.W.).**

Pre-stressed concrete.

London, Chapman and Hall, Ltd., 37, Essex Street, W.C.2. (Price : 60 s.)

1958 621 .431 .72

The development of the railcar.

One volume (7 1/4 × 4 3/4 in.) of 56 pages.

Lingfield, Surrey. The Oakwood Press, Bucklands. Tandridge Lane. (Price : 6 s. 6 d.)

1957 691

McHARDY YOUNG (J.).

Reinforced concrete, 3rd ed.

One volume, 190 pages, figs., tables.

London, Crosby Lockwood. (Price : 12 s. 6 d.)

1958 621 .431 .72

The diesel-electric shunting locomotive.

One volume (8 1/2 × 5 1/2 in.) of 80 pages.

Shrewsbury, Wilding & Son Ltd., 33, Castle Street. (Price : 5 s.)

1958 385 (09 (44)

VIVIAN ROWE.

French Railways of today.

One volume (8 × 5 1/2 in.) of 152 pages.

London, George G. Harrap & Co. Ltd., 182, High Holborn, W.C.1. (Price : 10 s. 6 d.)

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conjointly with the Office Bibliographique International, of Brussels, (See « Bibliographical Decimal Classification as applied to Railway Science », by L. WEISSENBRUCH, in the number for November 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

[016. 385 (05]

II. — PERIODICALS.

In French.

ACEC Revue. (Charleroi.)

1958 621 .335 (675)
ACEC Revue, nº 2, p. 2.
LAMBERTS (P.) & MIGNON (G.). — Les **locomotives « monophasées 50 Hz »** de la série BCK 2.200. (7 000 mots & fig.)

1958 621 .335
ACEC Revue, nº 2, p. 23.
GRANIER (E.). — Le **contrôle de freinage rhéostatique des locomotives monophasées**. (3 500 mots & fig.)

Acier - Stahl - Steel. (Bruxelles.)

1958 624 (43)
Acier-Stahl-Steel, septembre, p. 367.
SCHREIER (G.). — **Le pont « Nordbrücke »** à Düsseldorf. Calcul, préparation, assemblage et montage des travées fluviales du pont. (7 000 mots & fig.)

1958 624
Acier-Stahl-Steel, septembre, p. 382.
ROLAND (Ed.). — **Calcul des portiques simples et continus** de forme quelconque. (7 000 mots & fig.)

Bulletin de l'Association Suisse des Electriciens. (Zürich.)

1958 621 .31
Bulletin de l'Association Suisse des Electriciens, 13 septembre, p. 911.
BÜHLER (H.). — **Methoden zur Erregung von Synchronmaschinen.** (4 000 mots & fig.)

Bulletin des C.F.F. (Berne.)

1958 656 .2 (494)
Bulletin des C.F.F., septembre, p. 134.
WICHSER (O.). — La **planification des travaux et de l'exploitation** aux Chemins de fer fédéraux. II. (1 500 mots.)

1958 614 .8
Bulletin des C.F.F., septembre, p. 136.
HUMBEL (E.) & KRADOLPHER (H.). — **Accidents dus au courant électrique** et possibilités de ranimer les blessés au moyen du brancard basculant « Schaffhouse ». (1 200 mots & fig.)

1958 656 .254 (494)
Bulletin des C.F.F., septembre, p. 138.
L'**installation de sécurité télécommandée** de Dopple-schwand-Romoos. (1 000 mots & fig.)

1958 656 .222 .6 (494)
Bulletin des C.F.F., octobre, p. 150.
DIRLEWANGER (H.). — La **Suisse, pays de transit des marchandises par chemin de fer**. (1 300 mots.)

1958 621 .335 (44)
Bulletin des C.F.F., octobre, p. 155.
Eléments automoteurs S.N.C.F. Saint-Gervais-Vallorcine. (400 mots & fig.)

1958 656 .212 .5 (44)
Bulletin des C.F.F., octobre, p. 159.
Electrification Lyon-Avignon-Marseille. La **gare de triage centrale d'Avignon**. (1 000 mots & fig.)

Bulletin S.E.M. (Bruxelles.)

1958 621 .31
Bulletin S.E.M, nºˢ 2 et 3, p. 1.
Transformateurs de grande puissance. (5 000 mots & fig.)

Bulletin de la Société Belge des Electriciens. (Bruxelles.)

1958 621 .31
Bull. de la Soc. belge des Electriciens, juillet-septembre, p. 1[illegible].
d'ADLER-RACZ (J.). — Méthodes de **recherche des défauts de câbles**, et présentation de quelques appareils de conception récente. (5 000 mots & fig.)

Bulletin de la Société Française des Electriciens. (Paris.)

1958 621 .31
Bulletin de la Soc. Franç. des Electriciens, juin, p. 380
DEMONTVIGNIER (M.). — Les **onduleurs autonomes**. Accumulateurs de courant alternatif et convertisseurs de fréquence. (5 000 mots & fig.)

Bulletin Oerlikon. (Zürich.)

1958 621 .33
Bulletin Oerlikon, nº 326, février, p. 15.
BODMER (C.). — Un **nouveau genre de fixation des bobines polaires de moteurs de traction**. (600 mots & fig.)

Bulletin Technique de la Suisse Romande (Lausanne.)

1958 625 .245 (494)
Bull. Techn. de la Suisse Romande, 13 septembre, p. 31
BERGIER (P.). — Le **nouveau wagon à 18 essieux des C.F.F.** (1 000 mots & fig.)

Bulletin de l'Union Internationale des Chemins de fer. (Paris.)

1958 **385** (061 .5

Bull. de l'Union Intern. des ch. de fer, septembre-octobre, p. 272.

L' adaptation aux besoins actuels de l'Union Internationale des chemins de fer. (3 000 mots.)

1958 **385** .113 (3) & **385** (09 (3)

Bull. de l'Union Intern. des ch. de fer, septembre-octobre, p. 281.

Les **Chemins de fer en 1957.** (*Septième partie.*) (1 500 mots & tableaux.)

Electricité. (Paris.)

1958 **621** .31

Electricité, juin, p. 227.

BACLET (J.). — Un nouveau procédé d'**extinction des feux de transformateurs.** (2 000 mots & fig.)

1958 **621** .31

Electricité, juin, p. 233.

LORACH (M.). — La fabrication des **semi-conducteurs.** (2 000 mots & fig.)

1958 **621** .31

Electricité, juillet-août, p. 307.

HÉMARDINQUER (P.). — **Transformateurs à réglage en charge de la tension et à rupteurs dans l'air.** (2 000 mots & fig.)

Génie Civil. (Paris.)

1958 **669**

Génie Civil, n° 3477, 15 septembre, p. 375.

BASTIEN (P.) & MARGERAND (R.). — **Relations d'orientation entre une phase instable d'un acier et la phase résultant de la déformation plastique de celle-ci.** (1 000 mots & fig.)

L'Industrie des Voies ferrées et des Transports automobiles. (Paris.)

1958 **625** .2

L'Industrie des Voies ferrées et des Transports automobiles, septembre, p. 119.

Conformation humaine et construction des véhicules. (5 000 mots, tableaux & fig.)

Industries et Sciences. (Rhode-St-Genèse-lez-Bruxelles.)

1958 **621** .116

Industries et Sciences, n° 3, septembre, p. 9.

BROIDA (V.). — Etude analytique des anomalies de fonctionnement des **détendeurs de vapeur.** (6 000 mots & fig.)

Revue Brown Boveri. (Baden.)

1958 **621** .436

Revue Brown Boveri, mars, p. 108.

SCHMID (R.). — Un auxiliaire du moteur Diesel : le **turbo-compresseur de suralimentation.** (2 000 mots & fig.)

1958 **621** .431 .72 (494)

Revue Brown Boveri, mars, p. 142.

KLINGELFUSS (E.M.). — **Nouvelles locomotives Diesel-électriques** des Chemins de fer fédéraux suisses. (1 800 mots & fig.)

Revue Générale des Chemins de fer. (Paris.)

1958 **625** .1 (44)

Revue Générale des Chemins de fer, septembre, p. 437.

MAURY (M.). — **Déviation et mise en souterrain de la voie ferrée** entre les gares de Monaco et de Cap-Martin-Roquebrune. (800 mots & fig.)

1958 **625** .143 .5

Revue Générale des Chemins de fer, septembre, p. 440.

CASSÉ. — **L'influence de divers systèmes d'attache rail-traverse sur la rigidité transversale du châssis de voie.** Essais effectués à la S.N.C.F. (4 000 mots, tableaux & fig.)

1958 **385** (06 .4 (493)

Revue Générale des Chemins de fer, septembre, p. 453.

PORTEFAIX (A.). — Le **matériel de chemins de fer à l'Exposition Universelle et Internationale de Bruxelles.** (10 000 mots & fig.)

1958 **725** .31 (44)

Revue Générale des Chemins de fer, septembre, p. 478.

CHERRIER. — La **reconstruction des « bâtiments des voyageurs » des petites gares** sur la Région du Nord de la S.N.C.F. (1 200 mots & fig.)

Revuc Générale de Mécanique. (Paris.)

1958 **621** .8

Revue Générale de Mécanique, juillet-août, p. 333.

PATIN (P.). — Les **transmissions hydrauliques.** Transmissions hydromécaniques. (4 000 mots & fig.)

1958 **621** .9

Revue Générale de Mécanique, septembre, p. 385.

BERTHOUD (J.), DEMAREZ (H.), HESSE (A.) & PELISSIER (J.). — **Machines-outils et outillages d'usinage** à l'Exposition « Mécanelec 58 ». (46 pages avec fig.)

1958 **621**

Revue Générale de Mécanique, septembre, p. 433.

BLIN (A.). — **L'appareillage mécanique.** (5 000 mots & fig.)

La Technique Moderne. (Paris.)

1958 **621 .31**

La Technique Moderne, septembre, p. 421.

Les **onduleurs autonomes et leur utilisation pour l'alimentation de secours**. (1 000 mots & fig.)

Travaux. (Paris.)

1958 **721 .1**

Travaux, septembre, p. 874.

KERISEL (J.). — La **mécanisation des sols** : Recherches et investigations récentes. (3 000 mots & tableaux.)

La Vie du Rail. (Paris.)

1958 **625 .283 (44)**

La Vie du Rail, 7 septembre, p. 15.

Les **nouveaux locotracteurs** de la S.N.C.F., série Y-7100. (1 000 mots & fig.)

1958 **625 .1 (44)**

La Vie du Rail, 14 septembre, pp. 7, 8 et 11.

Terminus Poissy. **Quadruplement des voies** entre Achères et Poissy du km 22.513 au 25.950. — **Elargissement d'une troisième voie** entre Sartrouville et Maisons-Lafitte et extension de la commande centralisée. (1 200 mots & fig.)

1958 **621 .33 (83)**

La Vie du Rail, 21 septembre, p. 8.

Electrification de la ligne principale au Chili. (200 mots & carte.)

1958 **621 .33 (44)**

La Vie du Rail, 28 septembre, p. 3.

Electrification Est-Paris. (600 mots & fig.)

1958 **625 .245**

La Vie du Rail, 5 octobre, p. 8.

Essais de tamponnement de wagons-citernes à la station de Vitry. (1 500 mots & fig.)

1958 **656 .211 (45)**

La Vie du Rail, 12 octobre, p. 5.

TUNINETTI (M.A.). — La **double vie d'une grande gare** : Rome-Termini. (1 000 mots & fig.)

1958 **625 .23**

La Vie du Rail, 12 octobre, p. 8.

CASSY. — **A la recherche d'une voiture plus économique**. (1 000 mots & fig.)

1958 **656 .225**

La Vie du Rail, 12 octobre, p. 15.

FRANÇOIS (M.). — La **palettisation**, technique moderne de manutention et de transport. (3 000 mots & fig.)

In German.

Archiv für Eisenbahnwesen. (Berlin.)

1958 **656 (42)**

Archiv für Eisenbahnwesen, Heft 3, S. 261.

WOELKER (Ch.). — Die **Verkehrspolitik Grossbritaniens** in Vergangenheit und Gegenwart. (1 800 Wörter.)

1958 **38**

Archiv für Eisenbahnwesen, Heft 3, S. 298.

RAABE (K.-H.). — Der **Verkehr in der volkswirtschaftlichen Gesamtrechnung**. (5 000 Wörter & Abb.)

1958 **656 .213 (43)**

Archiv für Eisenbahnwesen, Heft 3, S. 311.

GENEST (A.). — Das **Recht der Privatgleisanschlüsse**, insbesondere die Allgemeinen Bedingungen für Privatgleisanschlüsse (PAB) vom 1. Januar 1955. (7 000 Wörter & Abb.)

Die Bundesbahn. (Darmstadt und Köln.)

1958 **697 (43)**

Die Bundesbahn, Nr. 15, August, S. 819.

GRAMATKE (W.). — **Probleme der Wärmewirtschaft bei der D.B.** (4 000 Wörter & Abb.)

1958 **656 .222 .5**

Die Bundesbahn, Nr. 16, August, S. 842.

von BARROS (M.). — **Aktuelle Probleme des Fernschnellverkehrs**. (6 000 Wörter.)

1958 **656 .257**

Die Bundesbahn, Nr. 16, August, S. 850.

FAKINER (F.). — **Senkung des Personalaufwandes durch Modernisierung**. (4 000 Wörter & Tafeln.)

1958 **385 .(**

Die Bundesbahn, Nr. 17, September, S. 880.

KRAFT (E.). — Die **inhaltliche Abgrenzung zwischen Staatsverträgen**, hierzu ergehenden Regierungsvereinbarungen und internationalen Verwaltungsabkommen (6 000 Wörter.)

1958 **656 .222 .4 (43**

Die Bundesbahn, Nr. 17, September, S. 889.

ZILLER (H.). — Der **sektionierte Fahrplan** bei de Deutschen Reichsbahn. (3 000 Wörter.)

Deutsche Eisenbahntechnik. (Berlin.)

1958 **625 .13 (4**

Deutsche Eisenbahntechnik, September, S. 425.

GEBHARDT (R.). & GERLOFF (K.). — D **Abbruch des Altenburger Eisenbahntunnels.** (*Schluss folg*
(5 000 Wörter & Abb.)

1958 625 .13 (43)
Deutsche Eisenbahntechnik, September, S. 434.
STRIEGLER (W.). — Die **Freilegung des Tunnels Altenburg** als geotechnisches Problem. (4 000 Wörter & Abb.)

1958 624 .62 (43)
Deutsche Eisenbahntechnik, September, S. 444.
NOACK (K.) & KÜHN (K.). — Die **neue Eisenbahnbrücke über die Havel bei Potsdam** im Zuge des Berliner Aussenringes. (4 000 Wörter & Abb.)

1958 624 : 691 (437)
Deutsche Eisenbahntechnik, September, S. 451.
NEUMANN (K.-H.). — **Spannbetonbrückenbau** in der C.S.R. (2 000 Wörter & Abb.)

Der Eisenbahningenieur. (Frankfurt am Main.)

1958 625 .1 : 621 .33 (43)
Der Eisenbahningenieur, Oktober, S. 281.
HANST (E.). — **Betriebliche und fahrplantechnische Massnahmen während der Profilfreimachung der linksrheinischen Tunnel für die Elektrifizierung.** (4 000 Wörter & Abb.)

1958 621 .335
Der Eisenbahningenieur, Oktober, S. 288.
KAISER (H.). — **Elektrische Lokomotiven auf Steilrampen.** (1 000 Wörter & Abb.)

1958 625 .245 : 621 .335
Der Eisenbahningenieur, Oktober, S. 290.
CURTIUS (E.W.). — Ein Messwagen zur **Untersuchung elektrischer Lokomotiven.** (2 000 Wörter & Abb.)

1958 621 .133 .3
Der Eisenbahningenieur, Oktober, S. 294.
LAMMERT (H.). — **Heizrohr — bezw. Überhitzerelementenwechsel** bei Bw'en mit schlechten Betriebswasserverhältnissen. (1 000 Wörter & Abb.)

1958 625 .282 (43)
Der Eisenbahningenieur, Oktober, S. 296.
Die **3 000 PS dieselhydraulische Lokomotive** der Lokomotivfabrik Krauss-Maffei, München. (800 Wörter & Abb.)

1958 614 .8 (43)
Der Eisenbahningenieur, Oktober, S. 298.
KAISER (B.). — Die neuen **Unfallverhütungsvorschriften für den Baudienst.** (1 800 Wörter.)

E.T.R.-Eisenbahntechnische Rundschau. (Köln-Darmstadt.)

1958 625 .243
Eisenbahntechnische Rundschau, August, S. 311.
HOFER (B.) & LORCH (E.). — Die **Fertigung der Gms 54-Wagen** im Ausbesserungswerk Fulda. (4 000 Wörter & Abb.)

1958 625 .143 .3
Eisenbahntechnische Rundschau, August, S. 318.
DRESSLER (A.). — **Ausbröckelungen und Werkstoffüberschiebungen auf den Fahrflächen von Eisenbahnschienen.** (1 500 Wörter & Abb.)

1958 625 .28
Eisenbahntechnische Rundschau, August, S. 321.
BRETTMANN (E.). — **Zugförderungskosten in Abhängigkeit von Streckenneigung und Geschwindigkeit.** (4 000 Wörter, Tafel, & Abb.)

1958 656 .257 (43)
Eisenbahntechnische Rundschau, August, S. 329.
WALTENBERG (H.) & OHLEMUTZ (A.). — Das **Gebäude des neuen Zentralstellwerks** im Hauptpersonenbahnhof Frankfurt (Main). (3 000 Wörter & Abb.)

1958 656 .253
Eisenbahntechnische Rundschau, August, S. 337.
HOCH (J.). — **Behinderung der Signalsicht** bei Zugbegegnungen in Linkskurven. (2 000 Wörter & Abb.)

Elektrische Bahnen. (München.)

1958 621 .337
Elektrische Bahnen, Heft 8, S. 169.
HILSENBECK (K.). — Die **elektrische Widerstandsbremse** der Lokomotive Baureihe E 50. (3 000 Wörter & Abb.)

1958 621. 335 (43)
Elektrische Bahnen, Heft 8, S. 176.
SANDNER (F.) & BRAUER (A.). — Die **elektrische Ausrüstung der schweren Güterzuglokomotive** Baureihe E 50 der Deutschen Bundesbahn. (*Schluss.*) (2 200 Wörter & Abb.)

1958 621 .332
Elektrische Bahnen, Heft 8, S. 181.
KAMMERER (A.). — **Teilkapazitäten und Erdschlussströme von Bahnstromleitungen.** (4 000 Wörter & Abb.)

1958 621 .335 (436)
Elektrische Bahnen, Heft 9, S. 193.
ROTTER (R.). — **Neue Typenreihe elektrischer Triebwagen** bei den Österreichischen Bundesbahnen. (*Fortsetzung folgt.*) (6 000 Wörter & Abb.)

1958 621 .332 (43)
Elektrische Bahnen, Heft 9, S. 204.
FRITSCHE (R.). — Die **110 kV - Bahnstromleitung Mainz-Bingen.** (5 000 Wörter, Tabellen & Abb.)

1958 621 .332
Elektrische Bahnen, Heft 9, S. 214.
TRAUSCHEL (E.). — **Selbsttätig nachgespannte Einfachaufhängung an Beiseilen** für Strassen- und Vorortbahnen. (1 000 Wörter.)

Elektrotechnik und Maschinenbau. (Wien.)

1958 **621** .31

Elektrotechnik und Maschinenbau, 1. Oktober, S. 554.

NACKE (H.). — **Einfache Bestimmung des Kreisdiagramms der Asynchronmaschine aus dem Ersatzschaltbild.** (1 000 Wörter & Abb.)

Glasers Annalen. (Berlin.)

1958 **621** .335 (469)

Glasers Annalen, August, S. 260.

VETTERS (L.). — Die **elektrische Ausrüstung der dreiteiligen Triebzüge Baureihe 2000** für Einphasen-Wechselstrom 50 Hz, 25 kV der Companhia dos Caminhos de Ferro Portugueses. (3 000 Wörter & Abb.)

1958 **625** .2

Glasers Annalen, August, S. 266.

SPERLING (E.) & BETZHOLD (Ch.). — Über ausgeführte **Schwingungs- und Festigkeitsversuche an Eisenbahnfahrzeugen.** (6 000 Wörter, Tafeln & Abb.)

1958 **625** .22

Glasers Annalen, August, S. 276.

WEINERT (O.). — Graphische Verfahren zur **Bestimmung der unteren Einschränkung von Eisenbahnwagen.** (1 000 Wörter, Tafel & Abb.)

1958 **625** .3 (43)

Glasers Annalen, August, S. 284.

Die **Alweg-Bahn.** (800 Wörter & Abb.)

1958 **625** .233

Glasers Annalen, September, S. 310.

BÖHM (H.). — **Schaltvorgänge und Bemessungsregeln bei Wechselrichtern** mit rotierendem Quecksilberstrahl für Zugbeleuchtung mit Leuchtstofflampen. (3 000 Wörter & Abb.)

1958 **625** .151

Glasers Annalen, September, S. 317.

HADANK (K.). — **Verschleissuntersuchungen an Weichenherzstücken.** (1 200 Wörter & Abb.)

1958 **625** .216

Glasers Annalen, September, S. 320.

WEINERT (O.). — **Graphische Bestimmung des Puffertellerdurchmessers.** (700 Wörter & Abb.)

Internationales Archiv für Verkehrswesen. (Mainz.)

1958 **385** .11

Internationales Archiv für Verkehrswesen, Nr. 14, 2. Juliheft, S. 281.

BERKENKOPF (P.). — Zur Frage der **Investitionen im Verkehrswesen.** (5 000 Wörter.)

1958 **656** .223

Internationales Archiv für Verkehrswesen, Nr. 14, 2. Juliheft, S. 288.

KRAUSE (H.). — **Kann die Eisenbahn Güterwagen in gleicher Weise einsetzen wie Personenwagen?** (2 000 Wörter.)

1958 **656**

Internationales Archiv für Verkehrswesen, Nr. 14, 2. Juliheft, S. 292.

TITZHOFF (P.W.). — Vom **Wettbewerb Schiene-Luft.** (2 000 Wörter & Tafel.)

1958 **385** .11

Internationales Archiv für Verkehrswesen, Nr. 15-16, Augustheft, S. 305.

MÖHLE (F.). — **Investitionen, Abschreibungen und ihre Finanzierungen.** (7 000 Wörter.)

Der Öffentliche Verkehr. (Bern.)

1958 **656** .2 (494)

Der Öffentliche Verkehr, Oktober, S. 3.

Die **Zusammenarbeit der Schweizerischen Eisenbahnen.** (2 500 Wörter.)

Schweizerisches Archiv für Verkehrswissenschaft und Verkehrspolitik. (Zürich.)

1958 **656** .2 (494

Schweiz. Archiv für Verkehrswissenschaft und Verkehrspolitik, Nr. 3, S. 225.

WICHSER (O.). — Die **Bau- und Betriebsplanung** be den Schweizerischen Bundesbahnen. (5 000 Wörter.)

1958 **656** (485

Schweiz. Archiv für Verkehrswissenschaft und Verkehrspolitik, Nr. 3, S. 255.

SJÖBERG (A.). — Das **Problem Eisenbahn-Kraftwagen** in der schwedischen Verkehrspolitik. (6 000 Wörte & Abb.)

In English.

The Engineer. (London.)

1958 **656** .25 (4

The Engineer, August 1, p. 179.

Signalling for main line electrification. (2 500 words

1958 **621** .431 .72 (4

The Engineer, August 1, p. 180.

British railways main-line diesel-electric locomotiv (2 700 words & figs.)

1958 **621** .131 .3 (4

The Engineer, August 15, p. 246; August 22, p. 28

LIVESAY (E.H.). — **French locomotive experienc** (9 800 words & figs.)

1958 656 .211 .7 (44)
The Engineer, August 22, p. 293.
TRIPP (G.W.). — **Another car ferry — M.V. « Compiègne »**. (1 200 words & figs.)

1958 621 .431 .72 (42)
The Engineer, August 22, p. 294.
Railbuses on British Railways. (1 100 words & figs.)

Engineering. (London.)

1958 62
Engineering, August 15, p. 212.
ERSKINE CROSSLEY (F.R.). — **Non-linear vibrations in mechanical systems.** (4 500 words & figs.)

1958 621 .431 .72 (42)
Engineering, August 15, p. 221.
Main-Line Diesel-electric locomotives. (300 words & figs.)

1958 621
Engineering, September 5, p. 304.
EDWARDS (G.). — **Nuclear propulsion.** (11 000 words & figs.)

1958 656 .255
Engineering, September 26, p. 423.
Testing packing methods for transport anywhere. (1 000 words & figs.)

Indian Railways. (New Delhi.)

1958 385 .4 (54)
Indian Railways, June, p. 341.
BALIGA (B.S.D.). — **How public relations can aid administration.** (1 400 words.)

Proceedings, The Institution of Mechanical Engineers. (London.)

1957 621 .431 .72
Proceedings, The Institution of Mechanical Engineers, Volume 171, No. 23, p. 717.
DYSON (A.), RICHARDS (L.J.) and WILLIAMS (K.R.). — **Diesel engine lubricants** : their selection and utilization with particular reference to oil alkalinity. (24 pages, illustrated.)

1957 625 .214
Proceedings, The Institution of Mechanical Engineers, Volume 171, No. 28, p. 795.
SHAWKI (G.S.A.). — **Journal bearing performance for combinations of steady, fundamental and harmonic components of load.** (16 pages, illustrated.)

International Transport Worker's Journal (London.)

1958 656 .25
International Transport Worker's Journal, No. 8-9, August-September, p. 179.
WALTERS (D.). — **Electronics aids the railways.** (2 600 words & figs.)

The Locomotive. (London.)

1958 621 .431 .72 (42)
The Locomotive, August, p. 152.
Diesel-hydraulic 300 HP shunting locomotives for British Railways. (400 words & figs.)

1958 621 .431 .72
The Locomotive, August, p. 154.
The exclusion of dirt from Diesel locomotives. (3 400 words.)

1958 621 .132 .1 (42)
The Locomotive, September, p. 163.
NOCK (O.S.). — **The locomotives of Sir William Stanier. IV.** (*to be continued.*) (2 600 words & figs.)

1958 621 .431 .72 (42)
The Locomotive, September, p. 167.
North British-G.E.C. type I Diesel-electric locomotives for British Railways. (1 400 words & figs.)

1958 621 .431 .72 (42)
The Locomotive, September, p. 169.
New railbuses for British Railways. (2 800 words & figs.)

Modern Railroads. (Chicago.)

1958 656 .212 (73)
Modern Railroads, July, p. 66.
SHEDD, Jr. (T.). — **P & LE's gateway yard.** Long, narrow, efficient. (700 words & figs.)

1958 625 .245 (73)
Modern Railroads, August, p. 49.
Special cars serve shippers. (2 200 words & figs.)

Modern Transport. (London.)

1958 625 .28 (42)
Modern Transport, August 9, p. 3.
POULTNEY (E.C.). — **British railways performance tests.** (3 000 words & figs.)

1958 656 .283 (42)
Modern Transport, August 9, p. 5.
Human element in rail collisions. (1 500 words & figs.)

1958 625 .232 (42)
Modern Transport, August 9, p. 10.
S.R. progress at Hastings. (1 800 words & figs.)

1958 621 .431 .72 (42)
Modern Transport, August 16, p. 13.
Derby-built Diesel power. (3 000 words & figs.)

1958 621 .431 .72 (42)
Modern Transport, August 23, p. 3; August 30, p. 7.
Railbuses on British Railways. (2 800 words & figs.)

1958 621 .133 .1 (42)
Modern Transport, August 23, p. 6.
Mechanical stokers. Three B.R. 2-10-0 Class 9 F fitted. (300 words & fig.)

1958 625 .232 (4)
Modern Transport, August 23, p. 11.
European sleeping and restaurant cars, (400 words & figs.)

1958 656 .222 .5 (42)
Modern Transport, August 30, p. 11.
ALDRIDGE (D.A.) & DAVISON (J.F.). — **Railway timetables.** Compilation on a digital computer. (1 600 words & figs.)

The Oil Engine. (London.)

1958 621 .431 .72 (47)
The Oil Engine, July, p. 108.
Modern equipment for the U.S.S.R. (1 000 words & figs.)

1958 621 .431 .72
The Oil Engine, July, p. 112.
Railcar gear control by automatic means. (700 words & figs.)

1958 621 .438
The Oil Engine, July, p. 119.
The gas turbine. — Gas turbine locomotive development surveyed. (2 500 words & figs.)

Railway Age, (New York.)

1958 656 .212 .5 (73)
Railway Age, August 4, p. 13.
Trains enter this yard-fast. (800 words & figs.)

1958 656 .23 (73)
Railway Age, August 18, p. 23.
LANGDON (J.). — **Now — an open door on rates.** (1 600 words.)

1958 625 .242 (73)
Railway Age, August 25, p. 11.
New hopper car proposed. (300 words & figs.)

1958 656 .25 (73)
Railway Age, August 25, p. 17.
Signals for 275 trains a day. (1 300 words & figs.)

Railway Engineering. (Cape Town.)

1958 625 .236 (68)
Railway Engineering, August, p. 24.
Sprays, nylon brushes clean 24 to 36 S.A.R. reef suburban coaches an hour. (1 200 words & figs.)

1958 621 .33
Railway Engineering, August, p. 26.
COOPER (B.K.). — **The 50-cycle system : A survey of its development and influence on electric traction.** (2 500 words & figs.)

1958 656 .2
Railway Engineering, August, p. 31.
BEVAN (G.T.). — **Track and bogie problems to consider when you change from steam to diesel operation.** (1 100 words & table.)

The Railway Gazette. (London.)

1958 625 .251)
The Railway Gazette, July 25, p. 100.
Braking control equipment. (1 500 words & figs.)

1958 621 .431 .72 (42)
The Railway Gazette, July 25, p. 103.
Type «2» Diesel-electric locomotives for British Railways. (1 200 words & figs.)

1958 621 .335 (485)
The Railway Gazette, August 1, p. 132.
Swedish State railways 5 500 HP single-phase locomotives. (1 700 words & figs.)

1958 621 .335 (494)
The Railway Gazette, August 1, p. 134.
Twelve-wheel single-phase 2 400 HP locomotives. (900 words & figs.)

1958 621 .33
The Railway Gazette, August 1, p. 131.
Return current through roller bearings. (600 words.)

1958 621 .138 .1 (42)
The Railway Gazette, August 8, p. 161.
Motive power depot at Thornaby, N.E. Region. (3 600 words & figs.)

1958 621 .335
The Railway Gazette, August 8, p. 158.
Electric locomotive maintenance practice. (2 000 words.)

1958 625 .143 .3
The Railway Gazette, August 8, p. 160.
Repairing rails damaged by slipping locomotives. (1 000 words.)

1958 621 .431 .72 (42)
The Railway Gazette, August 15, p. 191.
Park Royal railbuses for British Railways. (900 words & figs.)

1958 **621 .431 .72 (42)**
The Railway Gazette, August 22, p. 217.
Further design of railbus for British Railways. (1 100 words & figs.)

1958 **621 .431 .72 (42)**
The Railway Gazette, August 22, p. 219.
Light-service Diesel-electric locomotives for British Railways. (900 words & figs.)

1958 **656 .283 (42)**
The Railway Gazette, August 22, p. 226.
Ministry of Transport Accident Report : Little London level crossing, November 6, 1957; British Railways, Eastern Region. (1 000 words.)

1958 **625 .285**
The Railway Gazette, August 29, p. 246.
Fully-sprung motors. (3 000 words & figs.)

1958 **625 .236 (68)**
The Railway Gazette, August 29, p. 250.
Washing plant for S.A.R. reef electric stock. (2 400 words & figs.)

1958 **621 .338 (54)**
The Railway Gazette, September 5, p. 275.
Electric trains for Calcutta suburban services. (1 600 words & figs.)

1958 **625 .42 (42)**
Railway Gazette, September 5, p. 279.
Rolling stock for L.T.E. Metropolitan Line. (600 words & figs.)

Diesel Railway Traction. (London.)

1958 **621 .431 .72 (42)**
Diesel Railway Traction, July, p. 267.
Second railbus type for British railways. (1 500 words & figs.)

1958 **621 .431 .72**
Diesel Railway Traction, July, p. 270.
Thomas electro-mechanical transmission. (1 800 words & figs.)

1958 **621 .431 .72 (41)**
Diesel Railway Traction, July, p. 273.
Diesel traction on C.I.E. (2 500 words & figs.)

1958 **621 .431 .72 & 625 .174**
Diesel Railway Traction, July, p. 280.
Diesel snow plough. (1 200 words & figs.)

1958 **621 .431 .72**
Diesel Railway Traction, July, p. 284.
Diesel electric locomotive fundamentals. (2 500 words & figs.)

1958 **621 .431 .72**
Diesel Railway Traction, August, p. 291.
Large hydraulic transmission. (900 words & figs.)

1958 **625 .28**
Diesel Railway Traction, August, p. 293.
Economics of steam, diesel and electric. (1 600 words.)

1958 **621 .43 .172**
Diesel Railway Traction, August, p. 295.
Hunslet hydro-mechanical transmission. (700 words & figs.)

1958 **621 .431 .72 (43)**
Diesel Railway Traction, August, p. 296.
German three-axle locomotives. (800 words & figs.)

1958 **625 .251**
Diesel Railway Traction, August, p. 297.
Braking from high speeds. (2 200 words & figs.)

1958 **621 .431 .72 (43)**
Diesel Railway Traction, August, p. 300.
Mountain-line diesel operation. (1 000 words & figs.)

Railway Locomotives and Cars. (New York.)

1958 **621 .338 (73)**
Railway Locomotives and Cars, August, p. 21.
Budd Pioneers go into Pennsy M-U service. (2 400 words & figs.)

1958 **621 .33 (73)**
Railway Locomotives and Cars, August, p. 38.
Ninth AAR Electrical Section Meeting... Pacing Electrical Progress. (4 200 words & figs.)

1958 **621 .431 .72 (73)**
Railway Locomotives and Cars, September, p. 38.
Combustion characteristics of « Economy » fuels. (1 600 words.)

1958 **621 .431 .72 (73)**
Railway Locomotives and Cars, September, p. 60.
EMD goes to all-electric control. (2 000 words & figs.)

The Railway Magazine. (London.)

1958 **621 .431 .72 (41)**
The Railway Magazine, August, p. 570.
Changeover to diesel traction in Ireland. (2 500 words & figs.)

Railway Steel Topics. (Sheffield.)

1958 **625 .251**
Railway Steel Topics, No. 3, Vol. 4, p. 46.
HUNDY (B.B.). — **Tests on some special multiradius brake shoes.** (3 200 words & figs.)

Railway Signaling and Communications. (New York.)

1958 **656** .212 .6 (73)
Railway Signaling and Communications, July, p. 18.
Electronics sorts parcels. (1 200 words & figs.)

1958 **656** .212 (73)
Railway Signaling and Communications, July, p. 24.
Automatic classification yard in service. (4 500 words & figs.)

1958 **656** .254 (73)
Railway Signaling and Communications, August, p. 15.
Subway consolidates interlockings. (4 600 words & figs.)

1958 **625** .214 (73)
Railway Signaling and Communications, September, p. 36.
Special report on hot box detention. (3 400 words & figs.)

Railway Track and Structures. (Chicago.)

1958 **625** .172 (73)
Railway Track and Structures, June, p. 25.
RODGERS (B.T.). — **How the M & StL got a tighter grip on M-W inventory.** (1 300 words & figs.)

1958 **624** (73)
Railway Track and Structures, June, p. 28.
SHU-T'IEN LI. — **The case for all-welded bridges.** (2 300 words & figs.)

In Spanish.

Transportes. (Madrid.)

1958 **656** .23 (460)
Transportes, No. 65, p. 156.
IMEDIO (A.). — La **tarificación** de la Red Nacional de los Ferrocarriles Españoles. (3 000 palabras.)

1958 **625** .28 (460)
Transportes, No. 65, p. 180.
REDER (G.). — **Origen y desarrollo de la industria** de **material motor y movil** en España. (3 000 palabras & fig.)

1958 **656** (460)
Transportes, No. 65, p. 200.
SANCHEZ GAMBORINO (F.M.). — Las directrices legislativas de la **coordinación ferrocarril-carretera** en España. (2 000 palabras & fig.)

In Italian.

Giornale del Genio Civile. (Roma.)

1958 **624**
Giornale del Genio Civile, giugno, p. 373.
CESTELLI GUIDI (C.). — **Il calcolo a rottura delle travi di fondazione.** (4 000 parole & fig.)

1958 **624** .2
Giornale del Genio Civile, giugno, p. 401.
LA TEGOLA (A.). — Sul **periodo di vibrazione delle strutture in presenza di sforzi assiali.** (2 000 parole & fig.)

Rivista di Ingegneria. (Milano.)

1958 **625** .213
Rivista di Ingegneria, agosto, p. 905.
CHIESA (A.) & FRANCESCHETTI (S.). — Un nuovo impiego di una calcolatrice elettronica analogica : la **progettazione e la verifica delle sospensioni dei veicoli.** (1 500 parole & fig.)

In Netherlands.

De Ingenieur. (Den Haag.)

1958 **624** (492)
De Ingenieur, nr 37, 12 september, p. Bt. 93.
VAN ZUTPHEN (J.). — **Onderzoekingen aan een spoorwegviaduct** te Rotterdam. (*Slot.*) (3 000 woorden & fig.)

Spoor- en Tramwegen. (Den Haag.)

1958 **656** .222 .1 (492)
Spoor- en Tramwegen, nr 19, 11 september, p. 296.
Geen supersonische, wél **hogere snelheden dan normaal** tussen Blerick en Helmond. N.S. experimenten ten behoeve van het O.R.E. (1 000 woorden & fig.)

1958 **385** (06 .4 (493)
Spoor- en Tramwegen, nr 19, 11 september, p. 298.
JACOPS (A.). — De **spoorwegen op de wereldtentoonstelling Brussel 1958.** (1 500 woorden & fig.)

1958 **659**
Spoor- en Tramwegen, nr 19, 11 september, p. 300.
Public Relations en publiciteit in het verkeer. (2 000 woorden.)

1958 **621** .33
Spoor- en Tramwegen, nr 20, 25 september, p. 312.
KOSTER (J.P.). — **Elektrische tractie : Geschiedenis, betekenis, toekomst.** (5 000 woorden & fig.)

1958 **621** .33 (492)
Spoor- en Tramwegen, nr 20, september, p. 323.
HEYLIGERS (F.J.). — **Van wisselstroom naar gelijkstroom.** Een episode uit de geschiedenis van de elektrifikatie der Nederlandse Spoorwegen. (2 000 woorden & fig.)

1958 **621** .33 (492
Spoor- en Tramwegen, nr 20, 25 september, p. 326.
ANKERSMIT (J.E.J.). — Eén **halve eeuw elektrische tractie op de hoofdspoorwegen** in Nederland. (5 000 woorden & fig.)

1958 **621** .33 (492)

Spoor- en Tramwegen, nr 20, 25 september, p. 337.

VAN DER MEULEN (J.H.). — **De invloed van geografische en economische factoren op de geschiedenis van de elektrifikatie** van de Nederlandse Spoorwegen. (2 000 woorden.)

1958 **621** .33

Spoor- en Tramwegen, nr 20, 25 september, p. 341.

VAN STRIEN (C.P.) & VAN HOEFLAKEN (N.). — **Economische aspecten van de elektrifikatie.** (3 000 woorden & fig.)

In Portuguese.

Boletim da C.P. (Lisboa.)

1958 **656** .211 .5

Boletim da C.P., outubro, p. 4.

LIBÂNIO PEREIRA (A.). — **A mecanizacâo das bilheteiras das estacôes.** (2 000 palavras & fig.)

Técnica. (Lisboa.)

1958 **691**

Técnica, nº 284, julho, p. 733.

DE SOUSA COUTINHO (A.). — **Pozolanas, betôes com pozolanas e cimentos pozolânicos.** (*Conclusâo.*) (4 000 palavras, fig. & quadros.)

In Czech (= 91.886).

Železnični Technika. (Praha.)

1958 **656** .222 .1 (= 91 .886)

Železnični Technika, nº 9, p. 233.

SUSKE (A.). — **Graphic calculation of train loads.** (3 000 words & figs.)

1958 **624** (= 91 .886)

Železnični Technika, nº 9, p. 246.

DVOŘÁK (V.). — **Checking the safety of welded bridges.** (3 000 words & fig.)

In Serbo-croate (= 91.882).

Elektrotehniški Vestnik. (Ljubljana.)

1958 **621** .33 (= 91 .882)

Elektrotechniški Vestnik, May, June, p. 156.

LIČAR (J.). — **Mercury arc rectifier** for railway electric traction. (3 000 words & fig.)

M. Weissenbruch & Co., Ltd., Printer to the King, 49, rue du Poinçon, Bruxelles.

ANALYTICAL TABLE OF ARTICLES

ARRANGED ACCORDING TO THE DECIMAL CLASSIFICATION

(1958)

	Month.	Pages
Report (Austria, Belgium and Colony, Bulgaria, Cambodia, Czechoslovakia, Denmark, Ethiopia, Finland, France and French Union, Greece, Hungary, Indonesia, Italy, Lebanon, Luxemburg, Poland, Portugal and overseas territories, Rumania, Siam, Spain, Switzerland, Syria, Turkey, Viet-Nam and Yugoslavia), by A.S. CANAVEZES Jr. . .	April	49
Supplement to Report, by A.S. CANAVEZES Jr. .	August	126
Special Report, by Dr.-Ing. G.A. GAEBLER	September	134
Trans-Europ-Express trains and the contribution made thereto by the Deutsche Bundesbahn, by G.A. GAEBLER	February	20
The K L L-Express. Swedish light metal train, by E. ASPENBERG	December	167

625 .6 Light railways. Tramways.

In view of the development of light railways, what are the means to be adopted in order to reduce the operating costs of these railways and what are the resulting basic amendments ? Delimitation of electrification and dieselisation in relation to the traffic, capital costs and operating costs; co-ordination between rail and road : possibilities of mixed rail-road vehicles and of specialised vehicles for rail or road; principles to be followed in regard to investment, in order to improve the returns from the capital available for the transport industry. (Question 10, 17th. Congress) :		
Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Egypt, India, Irak, Iran, Republic of Ireland, Japan, Malaysia, New Zealand, Norway, Pakistan, South Africa, Sudan, Sweden, Union of Soviet Socialist Republics, United Kingdom of Great Britain and Northern Ireland and dependent overseas territories), by S.L. KUMAR	July	108
Report (Austria, Belgium and Colony, Bulgaria, Cambodia, Czechoslovakia, Denmark, Ethiopia, Finland, France and French Union, Western Germany, Greece, Hungary, Indonesia, Italy, Lebanon, Luxemburg, Netherlands, Poland, Portugal and overseas territories, Rumania, Siam, Spain, Switzerland, Syria, Turkey, Viet-Nam and Yugoslavia), by Dr.-Ing. Ernesto STAGNI.	August	121
Special Report, by S.L. KUMAR	September	144
Reorganisation of the concessionary Railways in Italy, by Prof. Dr.-Ing. E. STAGNI	October	146

651. OFFICE EQUIPMENT AND METHODS.

Advantage of the use of high speed electronic apparatus for certain administrative work such as : 1) the making out of pay slips; 2) traffic and stores accounts; 3) the checking of the movement of empty and loaded freight wagons, thereby improving the distribution of rolling stock; 4) compiling more rapidly already existing statistics, thus having also the possibility of preparing new ones. (Question 7, 17th. Congress) :		
Report (America (North and South), Australia (Commonwealth of), Burma, Ceylon, Egypt, India, Irak, Iran, Republic of Ireland, Japan, Malaysia, New Zealand, Norway, Pakistan, South Africa, Sudan, Sweden, Union of Soviet Socialist Republics and the United Kingdom of Great Britain and Northern Ireland and dependent overseas territories), by Sten UBBE . .	April	4.
Report (Austria, Belgium and Colony, Bulgaria, Cambodia, Czechoslovakia, Denmark, Ethiopia, Finland, France and French Union, Western Germany, Greece, Hungary, Indonesia, Italy, Lebanon, Luxemburg, Netherlands, Poland, Portugal and overseas territories, Rumania, Siam, Spain, Switzerland, Syria, Turkey, Viet-Nam and Yugoslavia), by B.H. de FONTGALLAND	May	69
Special Report, by B.H. de FONTGALLAND .	September	14

656. TRANSPORTATION. RAILROADING.

Die Internationale Verkehrsforschung in Deutschland *(Fundamental research into international transport questions in Germany) (New Books and Publications)*	April	6
Schweizerische Verkehrsstatistik 1956 *(Swiss Transport Statistics 1956) (New Books and Publications)*	"	6

PRINTED IN BELGIUM

M. WEISSENBRUCH & Co. Ltd.
Printer to the King
(Manag. Dir. : P. de Weissenbruch,
238, chaussée de Vleurgat, XL)
Edit. responsible : P. Ghilain